



Johns Hopkins Hospital

THE
HARRIET LANE HANDBOOK

*A Manual for
Pediatric House Officers*

6th EDITION

THE HARRIET LANE HANDBOOK

A Manual for Pediatric House Officers

THE HARRIET LANE HANDBOOK

A Manual for Pediatric House Officers

SIXTH EDITION



*The Harriet Lane Service,
Children's Medical and Surgical Center
of the
Johns Hopkins Hospital*

Editor

JERRY A. WINKELSTEIN, M.D.

YEAR BOOK MEDICAL PUBLISHERS, INC.

35 EAST WACKER DRIVE • CHICAGO

Copyright © 1972 by Year Book Medical Publishers, Inc.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without prior written permission from the publisher. Printed in the United States of America.

Reprinted, June 1973

Reprinted, April 1974

Library of Congress Catalog Card Number: 72-84258

International Standard Book Number: 0-8151-4911-5

NOTICE

Every effort has been made to ensure that the drug dosage schedules herein are accurate and in accord with the standards accepted at the time of publication. However, as new research and experience broaden our knowledge, changes in treatment and drug therapy occur. Therefore, the reader is advised to check the product information sheet included in the package of each drug he plans to administer to be certain that changes have not been made in the recommended dose or in the contraindications. This is of particular importance in regard to new or infrequently used drugs.

P R E F A C E
T O T H E S I X T H E D I T I O N

The content of the Harriet Lane Handbook has been determined by the pediatric house officers who have used it in the past. Because of rapid changes in pediatric procedures and practice they have found it necessary to once again revise its content but not its purpose.

The Handbook is still intended as a convenient, readily accessible synthesis of information useful to the pediatric house officer and pediatric practitioner. It is not intended to outline diagnostic or therapeutic approaches to the pediatric patient and cannot be substituted for basic pediatric knowledge or experience.

I wish to express my thanks to my fellow house officers whose cumulative experience and efforts have made this revision possible. I especially wish to thank Doctor William MacLean and the following Senior Assistant Residents: Doctors William Bartholome, Catherine De Angelis, David Goldstein, James Harris, David McDaniel, Martin Myers and Stephen Polmar. Special thanks are due to the Attending Staff for their contributions and advice. The guidance of Doctor Robert E. Cooke was particularly appreciated. Mr. Aaron Sopher has the unique ability to capture us on paper and we are pleased that he has allowed us to use his drawings in this edition.

Doctor James Hanson deserves special credit for his efforts in revising and enlarging the formulary. Special attention has been given to the specific use of each drug in a variety of clinical situations so that the physician may arrive at the most appropriate dose.

My thanks also go to Doctors Henry Seidel, Harrison Spencer, William Friedman, Robert Haslam, and Herbert Swick, editors of previous editions, whose contributions have in part been incorporated into this edition.

Finally, this revision would not have been possible without the invaluable assistance of Miss Bonnie Baranowski and Mrs. Christine Vossler.

Jerry A. Winkelstein, M.D.
Editor

Baltimore, Maryland
1972

TABLE OF CONTENTS

Preface

PART I - DIAGNOSTIC TESTS

Procedures.....	3
Obtaining Blood.....	3
Bone Marrow Aspiration.....	4
Suprapubic Aspiration of Urine.....	5
Tympanoparacentesis.....	6
Paracentesis.....	6
Thoracentesis.....	7
Venous Cutdown.....	8
Venous Pressure.....	8
Exchange Transfusion.....	9
Hematology.....	11
Routine Hematology.....	11
Tests for Bleeding Tendency.....	14
Miscellaneous Hematologic Studies.....	15
Nephrology.....	18
Routine Urinalysis.....	18
Miscellaneous Urinalysis.....	22
Urine Tests for Hemoglobin and Related Compounds.....	23
Tests of Renal Function.....	25
Cerebrospinal Fluid Examination.....	30
Synovial Fluid.....	33
Examination of Synovial Fluid.....	33
Characteristics of Synovial Fluids in Disease.....	34
Microbiological Examinations.....	35
Examination of Fresh Preparations and Stained Smears.....	35
Culture Methods.....	35
Stool Examination.....	37
Metabolic Tests.....	42
Tolerance Tests.....	42
Plasma Glucose.....	46
Miscellaneous Metabolic Tests.....	46
Tests of Upper Gastrointestinal Function..	51

Cardiology.....	56
Circulation Time.....	56
Cardiac Cycle.....	57
Electrocardiography.....	57
X-ray Contour of Heart.....	68
Normal Intracardiac Pressures.....	69
Endocrinology.....	70
Psychological Testing.....	88
Goodenough-Harris Draw-a-Person Test..	88
Denver Developmental Screening Test...	91
Preparations for X-ray Examinations.....	93
Dermatoglyphic Patterns.....	96
Skin Tests.....	97
Miscellaneous.....	100

PART II - FORMULARY

Drug Index.....	105
Drug Doses.....	109
Guide for Preoperative Medication.....	159
Intravenous Anti-Arrhythmic Drugs.....	160
Dosages of Antibiotics in Uremia.....	162
Drugs and Chemicals to be Avoided by Primaquine Sensitive Individuals.....	164

PART III - THERAPEUTIC DATA

Fluid and Electrolyte Therapy.....	167
General Considerations.....	167
Maintenance Requirements.....	169
Deficit Therapy.....	171
Replacement of Concurrent Losses.....	172
Composition of Frequently Used Oral Solutions.....	173
Composition of Frequently Used Parenteral Fluids.....	174

Poisoning.....	175
Substances Absorbed by Activated	
Charcoal.....	175
Salicylate Poisoning.....	176
Potassium Intoxication.....	178
Lead Intoxication.....	179
Digitalis Intoxication.....	179
Burns.....	180
Management of Burns.....	180
Management of Lye Burns.....	182
Respiratory Care and Pulmonary Function....	183
Guide to Respiratory Care.....	183
Estimation of Nasotracheal Tube	
Length.....	184
Estimation of Endotracheal Tube	
Size.....	185
Blood Measurements in Various	
Acid-Base Disturbances.....	186
Shunt at Different Inspired Oxygen	
Mixtures.....	187
Bronchopulmonary Segments.....	188
Lung Volumes.....	189
Predicted Basal Tidal Volume.....	190
Infectious Diseases.....	191
Active Immunization.....	191
Passive Immunization.....	197
Incubation Periods and Isolation	
Periods for Some Common	
Contagious Diseases.....	200
Isolation Types and Techniques.....	202
Ketogenic Diet.....	204

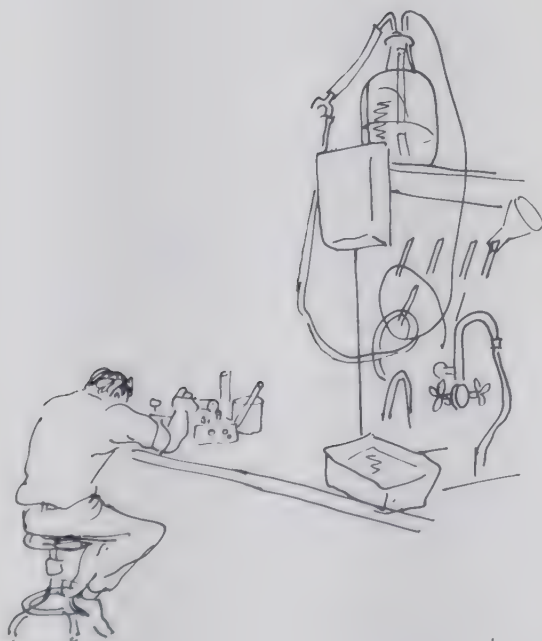
PART IV - REFERENCE DATA

Growth Tables.....	209
Normal Measurements in Relation to	
Age: Male and Female.....	209
Growth Charts.....	212
Head Circumference.....	216
Intrauterine Growth.....	218
Premature Growth Chart.....	220
Head Circumference/Age Chart for	
Prematures.....	221
Parent-Specific Age-Size Tables.....	222

Surface Area Nomogram.....	223
Bone Age.....	224
Age of Eruption of Deciduous Teeth....	226
Age of Eruption of Secondary or Permanent Teeth.....	227
Blood Pressure Tables.....	228
Nutrition.....	230
Recommended Daily Dietary Allowances..	230
Composition of Frequently Used Formulas.....	231
Sources of Protein, Fat and Carbohydrates in Various Formulas..	233
Comparison of Human Milk with Cow's Milk.....	235
Normal Laboratory Values.....	237
Blood Chemistries.....	237
Serology.....	241
Cerebrospinal Fluid.....	242
Immunoglobulin Levels at Different Ages.	243
McLean, Hastings Nomogram.....	245
Total Serum Proteins VS. Total Serum Solids.....	246
Red Cell Values During Gestation.....	247
Hematology.....	248
Normal Bone Marrow Values.....	249
Conversion Formulas and Tables.....	250
Conversion Formulas.....	250
Temperature Equivalents.....	250
Conversion of Pounds and Ounces to Grams.....	251

PART I

DIAGNOSTIC TESTS



1944 - when Haplane Hospital -

Arnon Sopher 1954

P R O C E D U R E S

A. OBTAINING BLOOD

1. Capillary Blood

NOTE: If obtained from extremity previously heated to point of hyperemia, the capillary blood is nearly identical to arterial blood in acid-base properties. Use right hand if available.

- a. Heel and finger are convenient. Avoid heel pad.
- b. Heat will produce local hyperemia. Keep extremity used in dependent position.
- c. Use No. 11 Bard-Parker blade or deep lancet stab.
- d. Wipe away first drop of blood with dry sponge. Alcohol used in sterilizing skin may produce hemolysis.
- e. Massage extremity but avoid squeezing finger or heel.

2. External Jugular Puncture

- a. Wrap infant in mummified manner.
- b. Turn head to one side and extend.
- c. Prepare area carefully.
- d. Provoke child to cry in order to distend external jugular vein.
- e. When needle is withdrawn, apply pressure and hold child upright.

3. Femoral Puncture

NOTE: Reported complication of septic arthritis demands careful and efficient skin antisepsis.

Ref: Pediatrics 38:837, 1966.

NOTE: Avoid femoral puncture in children that are scheduled for cardiac catheterization.

- a. An assistant is needed to hold child securely.
- b. The assistant stands behind the infant, leans over the head and trunk and holds the legs in semi-frog position. The arms of the infant are held down by the assistant's upper arms and elbows.
- c. Prepare area carefully as for blood culture.
- d. After locating the femoral pulse just below the inguinal ligament, insert needle, aiming slightly medial to the pulse beat.

- e. The needle is inserted slowly to a depth of approximately 0.5 to 0.75 cm.
- f. While suction is exerted, needle is slowly withdrawn until a small amount of blood enters syringe.
- g. If flow ceases, needle is pushed deeper and withdrawn as before.
- h. Both syringe and legs must be held stationary to insure drawing maximum amount of blood.

4. Internal Jugular Puncture

- a. Wrap infant securely in sheet.
- b. Place him on table and adjust position so that head falls over the side. With the neck extended, head is turned slightly to one side. This makes the posterior margin of the sterno-cleido-mastoid muscle on the opposite side stand out.
- c. Sterilize area.
- d. Needle is inserted just deep to and behind posterior margin of sterno-cleido-mastoid muscle, approximately halfway between its origin and insertion. Needle is then advanced under the muscle, parallel to skin surface and in direction of suprasternal notch, for a distance equal to width of sterno-cleido-mastoid.
- e. Needle is then slowly withdrawn while keeping a negative pressure on syringe, until point is reached at which blood enters syringe.
- f. After blood is obtained, hold child upright and apply pressure.

B. BONE MARROW ASPIRATION

1. General Comments and Warnings

- a. Bone marrow aspirations are always performed with sterile surgical technique.
- b. Skin, soft tissue and periosteum are anesthetized with Procaine.
- c. Needle is inserted with boring motion and steady but not excessive pressure.
- d. The classical description of a "give" when the marrow cavity is entered is not only unreliable, but also indicates loss of control.
- e. In children from birth to 6 months, the tibia is preferred site for aspiration.
- f. Iliac crest is technically superior in children 6 months to 11 years of age.
- g. No more than 0.2 ml of marrow should be aspirated, to minimize dilution with sinusoidal blood.

2. Iliac Marrow Technique

- a. Patient lies on side, and iliac area is sterilized.
- b. Anterior iliac crest is located at a point halfway between anterior and posterior spines.
- c. The ileum is entered 2 cm below the outer lip perpendicular to the other table.

3. Tibial Marrow Technique

Best obtained from medial aspect of the head of the tibia, below medial condyle and tibial tuberosity. Needle inserted perpendicular to outer table.

4. Spinous Process

- a. May be performed with patient in sitting position, leaning slightly forward.
- b. Third or fourth lumbar vertebrae are preferred as these are likely to present broadest spinous process.
- c. Needle is pushed through skin and inserted with rotary motion into the spinous process.
- d. Instead of puncturing tip of spinous process directly, needle can be introduced into one side of it. It is then passed medially, entering the bone anteriorly to the tip, at a point where cortex is less thick.

5. Smear Technique

- a. Eject marrow from syringe onto clean slide.
- b. With another syringe and needle, aspirate excessive blood and plasma from marrow to concentrate marrow.
- c. Using remaining marrow, make multiple smears in usual way.

C. SUPRAPUBIC ASPIRATION OF URINE

This technique of obtaining urine is most advantageous in suspect urinary tract infections when clean catch urines are inconclusive or contamination is suspected.

The infant's diaper should be dry or, in the older child, sufficient time should have elapsed since the last voiding to insure the presence of urine in the bladder. The child should be immobilized and the lower abdomen prepared as for blood culture. A syringe is fitted with a 22 gauge 1-1/2 inch needle. The symphysis pubis is located and the needle inserted 1-2 cm above the symphysis IN THE MIDLINE at an angle

10-20° to the perpendicular aiming slightly caudad. A perceptible change may be noted upon entering the bladder and with gentle suction the urine aspirated.

Ref: Pediatrics 36:132, 1965.

D. TYMPANOPARACENTESIS

1. Patient is "mummified" in standard manner. Restraining belts placed across chest and knees. Head is held firmly by assistant.
2. Anesthesia: Sedation is not usually necessary in infants and toddler. Sedation may be used with the larger child, more for the allaying of fear than for analgesia. A cotton pledget saturated with a topical anesthetic gives good local anesthesia.
3. Cerumen is gently removed with a wire curette.
4. The tympanic membrane and canal are swabbed with tincture of zephirin.
5. A 2-1/2 cc plastic syringe containing approximately 1 cc sterile saline is attached to a No. 18 3-1/3 inch spinal needle that has a double bend to permit visualization of needle point.
6. Posterior inferior quadrant of tympanic membrane is visualized using an otoscope with operating head.
7. The tympanic membrane is perforated and maximum negative pressure is applied for a few seconds.
8. The first drop is smeared on an alcohol-cleaned slide for the gram stain. One drop each on blood and chocolate agar plates and the rest into thioglycolate.

E. PARACENTESIS

Valuable as a diagnostic or therapeutic test for an abnormal collection of fluid within the peritoneal cavity.

1. Precautions

If paracentesis is performed for therapeutic measures, do not remove a large amount of fluid too rapidly because hypovolemia may result from rapid fluid shifts.

2. Technique

Surgical preparation and draping of the abdomen should be carried out.

- a. With patient in supine position, needle aspiration is best carried out just lateral to the rectus muscle in either the right or left lower quadrants.

- b. With patient in semi Fowler or cardiac position, a midline subumbilical aspiration is desired.
- c. Apply negative pressure as needle is inserted into the peritoneal cavity.
- d. Stop advancing needle once fluid appears in the syringe. Continue aspiration slowly with negative pressure until an adequate amount of fluid has been obtained for diagnostic studies.
- e. If upon entering the peritoneal cavity air is aspirated, withdraw the needle immediately. Aspirated air indicates entrance into a hollow viscus. (In general, penetration of a hollow viscus during paracentesis does not lead to complications.) Paracentesis should then be repeated with sterile equipment.

F. THORACENTESIS

Valuable as a diagnostic or therapeutic test for an abnormal collection of fluid within the pleural space.

Ideally, it should be performed with the patient sitting on the side of the bed, with an assistant standing in front to support him. Selection of the interspace to be tapped is made on the basis of dullness to percussion and the level of effusion on the erect chest x-ray.

1. Precautions

Thoracentesis should be performed with care in order to avoid pneumothorax, lung puncture or trauma to vessels under the rib.

2. Technique

- a. Surgical preparation and draping of the chest should be carried out.
- b. It is desirable to use a local anesthetic for the interspace to be entered.
- c. A large bore needle attached to a 3-way stopcock and syringe are the necessary equipment. With needle bevel down, insert into pleural space on top of the rib.
- d. As the pleural space is entered, negative pressure should be applied on the syringe.
- e. The desired amount of fluid is then withdrawn slowly.
- f. At the end of the procedure, the needle is withdrawn and a band-aid should be placed over the thoracentesis site.

NOTE: One should get a follow-up chest x-ray after thoracentesis to rule out pneumothorax.

G. VENOUS CUTDOWN

Readily accessible veins are the external jugular as it crosses the sterno-cleido-mastoid muscle below the angle of the mandible, and the long saphenous just anterior to the medial malleolus. A venous cutdown should be performed under careful aseptic conditions and thereafter treated as a potential source of local and/or systemic infections.

A surgical preparation of the skin is carried out and a transverse incision is made directly over the vein selected. The vein is isolated by blunt dissection and two 3-0 chromic sutures are placed about the vein. The distal ligature is then tied and used for traction. An oblique incision is made in the vein and the appropriate beveled silastic catheter, previously filled with saline, is inserted the desired length and the proximal ligature is tied snugly about the vein and catheter. The skin incision should be closed with fine silk and an additional silk ligature about the catheter in the skin to secure the catheter externally. An antibiotic ointment is placed over the wound and a dressing is applied.

H. VENOUS PRESSURE

1. Equipment

Syringe, saline, 3-way stopcock, spinal manometer and an 18-20 gauge needle (in smaller infants, a 22 or 23 gauge needle may be necessary).

2. Technique

- a. Assemble the 3-way stopcock with the syringe filled with sterile saline, the manometer placed vertically and the needle attached to the male hub.
- b. Fill both the manometer and the needle with saline from the syringe.
- c. With the infant supine, venipuncture a large vein.
- d. Allow the saline from the manometer to run into the vein and read the pressure as the vertical distance in centimeters between the meniscus in the manometer and the right atrium.

3. Precautions

- a. Falsely elevated pressures:
 - 1) Patient crying
 - 2) Constriction of vein by an external pressure
 - 3) Expiratory dyspnea

- 4) Positive pressure respirators
- b. The larger the needle the more accurate the readings.
- c. Manometer must be vertical.

4. Use of Central Venous Cutdown

If central venous cutdown is in superior vena cava for fluid administration, it may be used for venous pressure determinations if catheter is flushed before each reading.

5. Normal Values

Values depend very much on the position and size of the needle or catheter. Average normal values differ and the individual's experience with the selected site and size of needle are important, but 8-12 cm H₂O are generally accepted as normal.

I. EXCHANGE TRANSFUSION

NOTE: Hct, reticulocyte count, peripheral smear, bilirubin, total protein, infant blood type and Coomb's test should be performed on pre-exchange sample of blood since they can no longer be of diagnostic value on post-exchange blood. If indicated, also save pre-exchange serum for serologic studies.

1. Routine Exchange: for removal of sensitized cells or bilirubin.
 - a. Cross match donor blood against maternal serum for first exchange and against post-exchange blood for subsequent exchanges.
 - b. Blood:
 - 1) Type: 0 negative (low titer) any-time. Infants type if no chance of maternal - infant incompatibility.
 - 2) Anticoagulant: ACD unless infant is acidotic or hypocalcemic.
 - 3) Temperature: Room temperature.
 - 4) Age: fresh up to 48 hours old.
 - c. Infant feeding: glucose-water p.o. or I.V. when exchange is indicated. Empty stomach if infant was fed within 4 hours of exchange.
 - d. Albumin: 1 gram/kg I.V. 1-2 hours before exchange except before first exchange for hemolytic disease.
 - e. Procedure:
 - 1) Provide for frequent monitoring and recording of heart and respiratory rates, temperature, color; a heat source; resuscitation equipment.
 - 2) Prep and drape patient and operator for surgery.

- 3) Cut umbilical cord 1 cm or less from skin margin and find thin-walled vein.
 - 4) Clear thrombi with forceps or catheter and insert catheter to: Minimum - until blood returns; Maximum - 1/2 to 2/3 of vertical distance from shoulder-tip to umbilicus.
 - 5) Measure venous pressure in cm of blood with ruler and record. Repeat after each 100 ml exchanged.
 - 6) Establish 20-30 ml deficit and use 20 ml increments in vigorous full-term infants. Smaller volumes for smaller, less stable infants. Do not allow cells in donor unit to sediment.
 - 7) Rate: 2-4 cc/kg/min avoiding mechanical trauma to patient and donor cells.
 - 8) Calcium gluconate 10% solution: 1-2 ml slowly I.V. for tachycardia, irritability or prolonged Q-T segments. Rinse tubing with NaCl before and after. Observe for bradycardia during infusion.
 - 9) Total volume exchanged should be 160 cc/kg up to one donor unit.
 - 10) Use last withdrawal for: Hct, smear, bilirubin and future cross-matching.
2. Exchange for Anemic Heart Failure: Have O negative concentrated RBCs in the delivery room. Immediately measure the infant's venous pressure, establish a deficit and replace with enough RBCs to correct anemia and failure. Allow infant to stabilize for a few hours if possible before attempting a full two volume exchange.
3. Complications
- a. Cardiovascular: Thrombo- or air emboli, thrombosis, arrhythmias, volume overload, cardiorespiratory arrest.
 - b. Chemical: Increased K⁺, Na⁺, decreased Ca⁺⁺, decreased glucose (esp. 2 hours post-exchange).
 - c. Hematological: Decreased platelets, overheparinization (may use 0.4 mg Protamine for each mg of heparin in donor unit).
 - d. Infectious: hepatitis, bacteremia.
 - e. Physical: injury to donor cells (especially from overheating), vascular or cardiac perforation, hypothermia.

H E M A T O L O G Y

A. ROUTINE HEMATOLOGY

(For normal values see Part IV-Reference Section)

1. Hemoglobin Estimation

Fill graduated tube of Sahli-Hellige Hemoglobinometer to the 10 mark with 0.1 N hydrochloric acid (1 cc concentrated hydrochloric acid to 99 cc distilled water). Obtain a drop of blood and draw it into the pipette to the 20 cu mm mark. Wipe tip and blow contents into the hydrochloric acid solution. Rinse once. Mix with a mixing rod. Let stand for 10 minutes. Dilute the fluid with water drop by drop, mixing after each addition, until it has exactly the same color as the comparison standards. The graduation corresponding to the surface of the fluid then indicates the percentage of hemoglobin.

2. White Blood Cell Count

Blood drawn up to the 0.5 mark and without delay Turk's solution or 3% acetic acid drawn up to 11 mark.

Count number of cells in 4 large (1 mm) squares after scanning with low power objective to ascertain whether the cells are evenly distributed.

Since each large square is 1 mm on the side, and the coverslip lies 0.1 mm above the ruled platform, the volume of each large square = 1 mm x 1 mm x 0.1 mm = 0.1 cu mm.

No. WBC/4 squares = No. WBC per 4 x 0.1 cu mm
= No. WBC per 0.4 cu mm

No. WBC in 1 cu mm = 10/4 x No. WBC in 0.4 cu mm, since dilution is 0.5-11 or 1:20, No. WBC per cu mm = No. WBC per 4 sq x 10/4 x 20 or
No. WBC per 4 sq x 50.

NOTE: When the leukocyte count is low (below 4,000 cu mm) it is advisable for greater accuracy to use 1:10 dilution. When the WBC is very high, it may be necessary to use the red cell counting technique.

3. Red Blood Cell Count

Blood drawn up to the 0.5 mark, tip is wiped clean and without delay diluting fluid (Hayem's solution or normal saline) is drawn up to the 101 mark.

Calculation: Area of 80 tiny squares = 80×0.0025 sq mm. R = No. of cells counted in 80 tiny squares, and blood has been diluted to 1:200. Then No. of cells in 1 cu mm = $R \times 200 \times 1/0.02 = 10,000 R$ or 10,000 times the number of cells in 80 tiny squares.

4. Eosinophil Count

Blood is diluted 1:20 with a diluting fluid designed to cause lysis of red blood cells.

2% aqueous eosin - 0.5 ml
Acetone - 1.0 ml

Add distilled water to a total volume of 10 ml (can store in refrigerator for 2 weeks).

Using a hemoglobin pipette, draw blood to 0.02 ml and add 0.38 ml of diluting fluid (1/20 dilution). Both sides of a Fuchs-Rosenthal counting chamber are filled and counts made (chamber ruled to have 16 large squares each 1 x 1 mm, so total area is 16 sq mm. The depth is 0.2 mm; therefore, the volume of the ruled area is 3.2 cu mm).

If E = No. of eosinophils counted in one ruled area, then the absolute eosinophil count/cu mm of blood =

$$\frac{E \times 20}{3.2} = 6.25 E$$

5. Platelet Count

- a. Estimate: An approximate estimate of the platelet count on paired coverslips can be made from simple observation of the Wright's smear. If platelets are seen on smear, severe thrombocytopenia can usually be ruled out. Always examine the periphery of the smear, as groups of platelets may be deposited in that area.
- b. Direct Method: An RBC pipette is filled with platelet solution (Rees-Ecker) which is immediately expelled. A film of fluid which tends to prevent the platelets from sticking to the glass is thus left inside the pipette. Blood obtained by finger puncture is then drawn to the 0.5 mark; platelet solution is added and drawn to the 101 mark. The pipette is mixed for 3 minutes as for the RBC count and the chamber filled in the usual manner. Platelets seen as small, round or oval, refractile, slightly bluish bodies lying singly or in clumps. Count made under high power in central, finely

ruled portion of counting chamber. All platelets seen in the 25 groups of 16 small squares are counted and this value is multiplied by 2,000 to give number per cu mm. Normal platelets count by this method is 200,000-300,000 per cu mm.

Rees-Ecker Solution:

Sodium citrate	3.8 gm
40% Formaldehyde	0.2 cc
Brilliant cresyl blue	0.1 gm
Distilled water	100.0 cc
Filter each time before use.	

6. Reticulocyte Count

Add 5 drops of New methylene blue and 5 drops of fresh blood (oxalate) to a Wasserman tube and mix. Allow to stand for 20 minutes. Make a smear and mount on a slide. Count 500 red blood cells on two separate smears (total 1,000 RBCs). Number of reticulocytes reported in per cent.

7. Wright's Staining Technique

- Place the air-dried smear, film side up, on a staining rack.
- Cover smear with undiluted Wright's stain and leave for 1 minute.
- Dilute with distilled water (approximately equal volume) until a metallic scum appears. Allow this diluted stain to act for 2-1/2 to 5 minutes.
- Without disturbing the slide, flood with distilled water and wash until thinner parts of film are pinkish red.

8. Hematologic Indices

- MEAN CORPUSCULAR HEMOGLOBIN (MCH) expresses ratio of hemoglobin to red cell count (the weight of hemoglobin in the average RBC) in absolute terms.

$$\text{MCH} = \frac{\text{Hgb (gm\%)} \times 10}{\text{RBC (millions per cu mm)}}$$

Result given in micromicrograms.

- MEAN CORPUSCULAR VOLUME (MCV) expresses the volume of the average RBC in absolute terms.

$$\text{MCV} = \frac{\text{Hematocrit} \times 10}{\text{RBC (millions per cu mm)}}$$

Result is given in cubic microns.

- c. MEAN CORPUSCULAR HEMOGLOBIN CONCENTRATION (MCHC) measures in absolute terms the concentration of hemoglobin in the average RBC.

$$\text{MCHC} = \frac{\text{Hgb (gm\%)} \times 100}{\text{Hematocrit}}$$

Result is expressed in per cent.

B. TESTS FOR BLEEDING TENDENCY

1. Bleeding Time (Ivy's Method)

NOTE: Bleeding time should not be done using the ear lobe (Duke's method). Forearm safer.

- Place sphygmomanometer cuff around upper arm and inflate to 40 mm Hg.
- At a point below the fold at the antecubital fossa, and not overlying a vein, make incision 2 mm deep and 2 mm long. (Arm should hang down and blood should drop freely.)
- When first drop of blood appears, start timing. Blot drops with filter paper every 30 seconds. Do not touch or manipulate wound.
- Record time when no further blood appears on paper. Normal: <6-1/2 minutes.

2. Clotting Time (Lee-White)

- Use 3 test tubes, 10 mm in diameter. Use size 18 or 20 needle. Rinse tubes, needle and syringe with sterile saline. Test tubes should be kept at body temperature by warming in hands or placing in incubator.
- Needle must enter vein on first attempt. Start timing.
- Remove needle and place 1 ml of blood in each tube, starting with tube #3. Do not squirt blood or shake tubes.
- Gently tilt tube #1 at 30 second intervals until it has clotted. Then tilt tube #2 until clotting, and finally tilt #3. Record time tube #3 clots. This is clotting time.
- Normal: 6-12 minutes. (If siliconed tubes used, time is approximately doubled.)

3. Clot Retraction

Three ml of blood are put in a Wasserman tube. Incubate at 38°C. Inspect after 1 hour and after 18-24 hours. Normally retraction of the clot and expression of serum is appreciable after 1 hour and marked

after 18 hours. When there is thrombocytopenia, polycythemia, or very low fibrinogen levels, clot retraction is delayed. Occasionally the clot of normal blood fails to separate from the walls of the tube. If the clot is loosened with an applicator, however, retraction should occur promptly.

Because this test represents a summation of the time required for both clotting and clot retraction, it may be artificially prolonged in the presence of a prolonged clotting time.

4. Clot Lysis

If fibrinogen levels are low ($\leq 50\text{mg\%}$), a clot will fall apart and resemble clot lysis. Apparent lysis of a clot within 1 hour after blood is drawn is abnormal. A normal person should have continuation of a good clot at 24 hours.

5. Tourniquet Test (Rumpel-Leede)

- a. Examine arm for petechiae and mark them.
- b. Apply blood pressure cuff on upper arm and inflate midway between systolic and diastolic pressures.
- c. Leave inflated cuff in place for 5 minutes.
- d. Remove cuff, wait 5 minutes, and inspect arm, wrist and hand for petechiae.

If petechiae appear in large numbers earlier than 5 minutes, release cuff immediately.

Comment:

- a) Petechiae commonly appear in the antecubital area, volar aspect of the wrist.
- b) Distribution of petechiae is usually irregular, and no effort should be made to count the number in a given area.
- c) The test is graded 1+ to 4+, depending on whether there are a few or very many. Normally, only very occasional petechiae are found or none at all.

C. MISCELLANEOUS HEMATOLOGIC STUDIES

1. Sedimentation Rate

- a. 5 ml venous blood is placed in oxalated or sequestrene bottle.
- b. Place 1 ml of this in Wintrobe tube. Determination should be done within 1 hour after blood is obtained.
- c. Place tube in special upright rack which is balanced in vertical plane.
- d. Read depth of fall of the red cell column at the end of 60 minutes.

- e. Normal values (mm/l hr - Wintrobe method):

Men	0-8
Women	0-15
Children	4-20

- f. Factors that increase rate of fall:
- 1) Anemia
 - 2) Tilting
 - 3) Warming
- g. Factors that decrease rate of fall:
- 1) Hypo- or afibrinogenemia
 - 2) Old or cold blood
 - 3) Excessive anticoagulant
 - 4) Sick cell anemia. Note: Oxygenate sickle cell blood before performing ESR.
 - 5) Congestive heart failure.
- h. NOTE: "Correction" of sedimentation rate for anemia is no longer recommended, but simultaneous hematocrit should be recorded.

2. Sickle Preparation

Any substance which reduces oxygen tension will cause the red cells of persons with sickle cell anemia or trait to sickle.

- a. Sulfite solutions: A drop of 2% sodium bisulfite or sodium hyposulfite may be used. Capsules of sodium bisulfite are available and the desired concentration is made fresh every day. These preparations should be read at 5 minutes, 60 minutes, 3 hours, and 12 hours.
- b. BAL solution (fresh): Use 1 drop of 10% injectable BAL plus 0.5 cc saline. Then use 1 drop of the supernatant saline-BAL mixture plus 1 drop of blood on coverslip. Invert coverslip on slide and ring with vaseline. Read at 5 minutes, 60 minutes, 3 hours, and 12 hours.

NOTE: Venous blood will sickle more readily than capillary blood. A suggested method of preparing the patient is to tourniquet the finger with a rubber band for 5 minutes before sticking the finger.

3. Osmotic Fragility (non-incubated) (Sanford's Method)

- a. To make 0.5% saline, add exactly 0.5 gm of pure, freshly dried sodium chloride to about 50 ml of distilled water in 100 ml volumetric flask, dissolve, and make up to volume with distilled water.
- b. Set up 2 rows of 12 small test tubes. One row is for the test on the patient's blood and the other for normal control.

- c. Number the tubes from left to right: 25, 24, 23, 22, 21, 20, 19, 18, 17, 16, 15, 14.
- d. With a capillary pipette, add to each tube the number of drops of 0.5% saline indicated by the number on the tube. With the same pipette, add the number of drops of distilled water needed to bring the contents of each tube to a total of 25 drops. Mix by shaking. The salt concentration in each tube is now the number on the tube multiplied by 0.02.
- e. Obtain blood by venipuncture and, with needle still attached to syringe, add 1 drop of blood to each tube. Mix.
- f. Let stand at room temperature for 2 hours. Record salt concentration at which there is first evidence of hemolysis (initial hemolysis). Record salt concentration at which no sediment of erythrocytes can be seen (complete hemolysis). Compare with control tubes.

Normal range:

- 1) Initial hemolysis (% Saline $\pm$ 1 S.D.)
0.44 $\pm$ 0.02
- 2) Complete hemolysis (% Saline $\pm$ 1 S.D.)
0.32 $\pm$ 0.02

NOTE: In some patients with congenital spherocytic hemolytic anemia, the abnormality is not detected unless osmotic fragility studies are conducted on defibrinated blood which has been incubated aseptically for 24 hours.

N E P H R O L O G Y

A. ROUTINE URINALYSIS

1. Colora. Endogenous:

- 1) Yellow brown-deep brown: bilirubin.
- 2) Red hues: hemoglobin, RBC's, porphyrins, urates.
- 3) Brown-black: old blood, hemosiderin, myoglobin, homogentisic acid, melanin (especially if alkaline).
- 4) Purple-brown: porphyrias (after specimen stands a few days).
- 5) Deep yellow: riboflavin.

b. Exogenous: See table on common exogenous urinary pigments on next page.2. Clarity3. Specific Gravity

a. Hydrometer.

b. Refractometer (American Optical Company T.S. Meter). Requires only 1 drop of urine. Principle: Refractive index of a solution is related to content of dissolved solids.

c. Osmolality. Freezing point depression methods.

4. pH - Nitrazine Paper5. Albumina. Sulfosalicylic Acid Test:

- 1) Add 8 drops of 20% sulfosalicylic acid to 1 ml of urine.
- 2) Mix equal amounts of urine and 3% sulfosalicylic acid. This test can be quantitated with commercial standards.
- 3) False positives: proteoses, tolbutamide, sulfonamides, penicillin, IVP dyes, PAS, phosphates, etc.

b. Heat Test:

Heat urine in boiling water for 5 minutes or over flame until boiling. If cloudiness occurs, add a few drops of 3% acetic acid. If cloudiness persists, it is due to albumin and not phosphate.
Interpretation: Faintly hazy +; definite haze 1+; cloud through which a print is legible 2+; heavier cloud 3+; immediate flocculation 4+.

c. Albustix (Ames Co.)

COMMON EXOGENOUS URINARY PIGMENTS

Substances	Source	Color of Urine	
		Acid	Alkaline
Anthraccine Derivatives) yielding) chrysophanic acid) (aloe, cascara,) rhubarb, and senna)) Antipyrine Beets Bromsulfalein Congo Red Hedulin Methylene Blue Phenol	Cathartics Analgesic Food Test dye Test dye Anticoagulant Proprietary Drugs Poisoning	Yellow-brown *Red Red Colorless Yellow Colorless Blue-green Colorless	Red-violet Yellow Red Red Red Gradual oxidation of hydro- quinone to olive to black pigment
Phenolphthalein phenolsulfonphthalein Povan Pyridium Red Candies Red Drug Flavorings Santonin Thymol	Cathartic Test dye Antihelminthic Analgesic Antihelminthic Antihelminthic	Colorless Colorless Red Red Red Red Yellow Colorless	Red Red Colorless Pink Thymol hydroquinone turns olive on oxidation

*pH changes not known

6. Reducing Substance

- a. Clinistix (Ames Co.): Specific for glucose.
- b. Testape (Eli Lilly Co.): Specific for glucose.
- c. Clinitest tablets (Ames Co.): Not specific for glucose. 5 drops urine, 10 drops water, 1 tablet. Compare with scale supplied. Reducing substances such as glucose, fructose, galactose, and pentose all give positive tests with Clinitest. Sucrose does not react.
- d. Benedict's Qualitative Test: Not specific for glucose. 10 drops of urine and 5 ml of Benedict's qualitative reagent. Mix and place in a boiling water bath for 5 minutes. Allow to cool to room temperature and read as follows:

Blue	Negative
Greenish blue	Trace
Green	0.5% reducing substance
Greenish brown	1% reducing substance
Yellow	1.5% reducing substance
Brick red	2% reducing substance

7. Acetone

- a. Acetest tablets (Ames Co.)) Directions
- b. Acetone test power (Denver)) from
- c. Ketostix (Ames Co.)) Manufacturer

8. Urine Gram Stain

- a. Purpose: To screen suspected urinary tract infections.
- b. Method: 1 drop of uncentrifuged clean catch or catheter obtained urine is Gram stained in usual manner.
- c. Interpretation: The stain will usually reveal bacteria if infection present. This has been subjected to quantitative evaluation, with almost all urine specimens with bacterial colony counts of 100,000 or more/ml showing organisms when stained by Gram's method. Obviously, a urine culture should be taken to confirm these results.

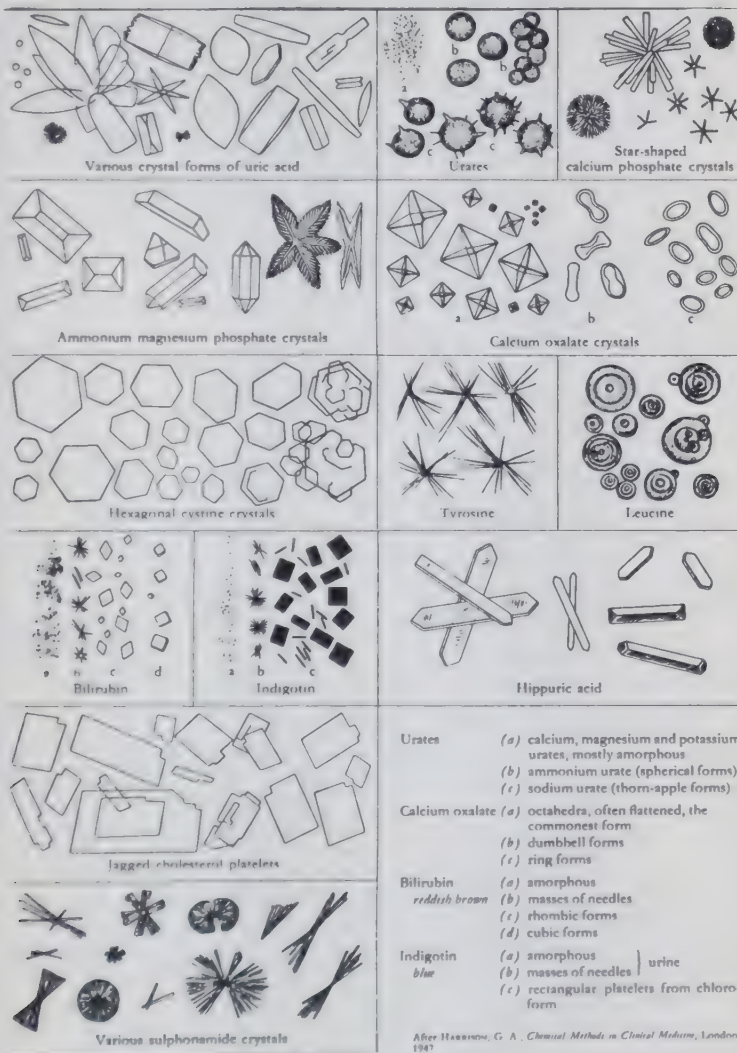
Ref: Ped. 23:441, 1959.
Ped. 26:441, 1960.

9. Sediment

Examine all fields for red cells, white cells, casts and crystals. Area at edge of coverslip should also be examined as formed elements collect there. See illustration on next page.

URINARY SEDIMENTS

Amorphous and Crystalline Chemical Sediments



After HARRISON, G. A. *Chemical Methods in Clinical Medicine*, London 1947

B. MISCELLANEOUS URINALYSIS

1. Tests for Urinary Reducing Substances Other Than Glucose

- a. General: Qualitative Benedict's and Clinitest (Ames) tablets give similar results. Glucose oxidase strips [Clinistix (Ames) and Tes-Tape (Lilly)] are absolutely specific for glucose. Very rare false negatives for glucose oxidase strips appear to be related to inhibition of enzyme in strip by compounds such as mercurials (e.g., Mercurhydrin). It is not uncommon for slight discrepancies to exist between Clinitest and Clinistix results.
- b. Non-glucose Reducing Substances:
 Ascorbic acid
 Fructose
 Galactose
 Homogentisic acid
 Lactose
 Pentose (xylose)
 Tyrosine and its derivatives in high concentration

NOTE: Sucrose is not a reducing sugar.

- c. Specific Tests
 Sugar chromatography is most specific and can be performed by specialized labs.

2. Cytomegalic Inclusion Disease

- a. Purpose: Large epithelial cells with intranuclear inclusions are frequently found in the urine of patients, especially neonatal infants, infected with human cytomegaloviruses. Isolating the virus in culture and finding these cells in the body fluids is a practical antemortem method of making this diagnosis. Absence of these cells in the urine does not exclude the diagnosis.
- b. Method:
 - 1) Fresh (!) urine is mixed 1:1 with 95% ethyl alcohol and centrifuged.
 - 2) The sediment is placed on one slide and allowed to run onto serial slides resulting in thin smears that will air dry rapidly.
 - 3) The smear is stained with toluidine blue or hematoxylin and eosin.
 - 4) Cells with intranuclear inclusions are sought under high dry magnification. The urine may also be passed through a milli-pore filter and the residue stained in situ and examined.

NOTE: The above methods can be applied to a variety of body fluids.

Ref: Ped. 15:270, 1955.

Am. J. Clin. Path. 22:424, 1952.

C. URINE TESTS FOR HEMOGLOBIN AND RELATED COMPOUNDS

1. Urine Hemoglobin

NOTE: A microscopic examination must be made to differentiate hemoglobinuria from hematuria.

- a. Occultest reagent tablets (Ames Co.):
See directions on package.
- b. Benzidine Test:
 - 1) Centrifuge urine and use sediment.
 - 2) Add 1 ml of saturated benzidine solution (in glacial acetic acid) and 1 ml of hydrogen peroxide.
 - 3) A bluish green color indicates hemoglobin.
- c. Guaiac:
 - 1) Acidify 5 ml of urine with glacial acetic acid.
 - 2) Add guaiac solution drop by drop until cloudiness appears.
 - 3) Add hydrogen peroxide drop by drop.
 - 4) A blue color indicates hemoglobin.

A more specific test utilizes ether extraction. To 10 ml urine add 1 ml glacial acetic acid and 10 ml ether. Shake thoroughly. Remove ether layer to another tube and do guaiac test on this material.

2. Urine Myoglobin

Dissolve 2.8 gm ammonium sulfate in 2 ml of urine. Hemoglobin is precipitated, whereas myoglobin stays in solution. Then repeat the benzidine test. Spectroscopic techniques are more accurate.

3. Urine Bilirubin

- a. Icto Test (Ames Co.)
- b. Harrison Spot Test: To 5 ml urine add 5 ml 10% BaCl_2 . Centrifuge or filter. Use supernatant for urobilinogen determination. Sediment contains the bile. Add 1 or 2 drops of Fouchet's reagent to the sediment. The blue or green-blue color of biliverdin indicates bilirubinuria.

Fouchet's Reagent: 25 gm of trichloroacetic acid in 100 ml water. When dissolved, add 10 ml of 10% FeCl_3 .

- c. Foam Test: Shake a few ml of urine.
Yellow foam suggests bile.

4. Urine Urobilinogen

a. Method:

- 1) Remove bile from urine (see No. 3 above.)
- 2) Use 6-10 test tubes with the same diameter.
- 3) Add 5 ml of water to all but the first tube.
- 4) Add 5 ml urine to first and second tubes. Mix second tube and transfer 5 ml to third, etc.
- 5) Add 0.5 ml Ehrlich aldehyde reagent (Wallace and Diamond).
- 6) Read last tube showing pink color. Must be read vertically with white paper under the test tube rack.

- b. Normal: 1:8-1:16 dilution.

Ehrlich Aldehyde Reagent: 2 gm para-di-methylaminobenzaldehyde is dissolved in 100 ml of 20% aqueous concentrated HCl.

5. Urobilin (Schlesinger's Test)

If bilirubin is present, it must be removed. Add 2 ml 10% calcium chloride solution to 2 ml saturated sodium carbonate solution to 10 ml of urine. Filter or centrifuge, using filtrate or supernatant as below. A normal control should be run. For semi-quantitative purposes serial dilutions may be set up.

To 10 ml of above filtrate (or to 10 ml of urine free of bile) add 1-2 drops of Lugol's solution. Add 10 ml of well-shaken Schlesinger's reagent. Filter and allow to stand for maximal development of color. A green fluorescence indicates presence of urobilin; this is best seen when the test tube is viewed in bright sunlight against a black background or when light is concentrated upon it with a lens. Report test positive only when degree of fluorescence exceeds control.

Schlesinger's Reagent

5 gm zinc acetate
95% alcohol qs ad 100 ml

Lugol's Solution

5 gm iodine
10 gm potassium iodine
Distilled water qs ad 100 ml

6. Hemosiderin

This may be seen as discrete golden granules in urinary sediment or may be present in casts. If such are seen, add a drop of 30% aqueous ammonium sulfite to a drop of urinary sediment. If the granules are hemosiderin, they will turn black (ferric sulfide).

A positive test indicates that hemoglobin has been passed into the renal tubules and there been converted to hemosiderin--usually the result of hemoglobinemia and hemoglobinuria. Hemosiderinuria may occur without manifest hemoglobinuria when the rate of excretion of hemoglobin is low. In paroxysmal nocturnal hemoglobinuria there is perpetual hemosiderinuria. It may also occur in hemochromatosis and intravascular hemolysis.

7. Alternative Test for Hemosiderin

- a. Centrifuge 15 cc urine.
- b. Mix sediment with 1 cc supernatant.
- c. Add equal volume of 2 or 5% HCl.
- d. To this mixture add 0.5 cc 10% aqueous solution of potassium ferrocyanide.

Positive test: Deep blue particles in sediment on microscopic examination.

D. RENAL FUNCTION TESTS

1. Endogenous Creatinine Clearance

- a. Purpose: This is a good measure of glomerular filtration rate (GFR) and closely approximates the inulin clearance in the normal ranges of GFR. With the low GFR of advanced renal disease, it is above the inulin clearances. Creatinine clearance per unit of surface area is constant.
- b. Method: Timed collection of urine is made for 24 hours, recording the nearest minute. No poultry is fed. Blood specimens are drawn at the beginning and end for serum creatinine. Hare and Hare method for true creatinine should be used.
- c. Calculation: Chromagen

$$Ccr = \frac{UV}{P} \times \frac{1.73}{S.A.}$$

U = urinary concentration of creatinine in mg/ml.

V = total volume of urine divided by number of minutes in the collection period = cc/min.
(N.B. 24 hrs = 1440 mins.)

P = average of the 2 plasma creatinine levels in mgm%
 S.A. = surface area in square meters

d. Normal Values:

- 1) Newborns and Prematures:
 40-65 ml/min/1.73 sq meters
- 2) 1-1/2 Years and Older:
 - a) Males
 124 ± 25.8 ml/min/1.73 sq meters
 - b. Females
 108.8 ± 13.5 ml/min/1.73 sq meters
- 3) Adults:
 - a) Males
 105 ± 13.9 ml/min/1.73 sq meters
 - b) Females
 95.4 ± 18 ml/min/1.73 sq meters

Ref: New Eng. J. Med. 266:317, 1962.
 Acta Paed. 48:443, 1959.

2. Dilution and Concentration Test

a. Concentration

A random urine S.G. of 1.023 or more indicates intact concentrating ability within the limits of clinical testing and no further tests are indicated.

Technique: Fluids are withheld for 12 hours. Normally, the urine S.G. will reach 1.023 or more under these conditions. If, at 12 hours concentration, this is not evident, pitressin responsiveness may be determined.

Caution: Fluid deprivation for only a few hours in the face of impaired concentrating ability can lead to dehydration, hypernatremia, and hypovolemic shock. Serial observations of body weight, hematocrit, serum protein, and serum sodium or osmolality are essential. Do not progress if patient loses 8% of body weight.

b. Dilution

Normally, if the fluid intake is increased to cause maximum diuresis, the S.G. will fall to 1.003 or less. Dilution are dangerous in patients with reduced GFR and rarely used.

Technique: 20-30 cc/kg of water (maximum 1000 cc) is ingested over 30-45 minutes. Voided specimens checked over the next 3 hours should reveal a S.G. of 1.003 or below. This is not a standard water load test.

3. Three Glass Test

With a full bladder initially, the patient is asked to void 2-3 ounces into a glass. This specimen will contain washings from the urethra. A similar amount is passed into a second glass; a sample of bladder urine. The prostate is then massaged and a third glass obtained, supposedly containing bladder and prostatic secretions. Examine each specimen for formed elements and culture each.

4. Addis Count

a. Purpose: Allows quantitation and standardization of the excretion of formed elements in the urine and is relatively free of error due to change in urine flow rate. Test is pointless if routine microscopic examination of the urine is positive.

b. Method: Fluid is restricted after 8 a.m. for adults or after 4 p.m. for children. Urine is collected from 7 p.m. to 7 a.m. Collection started after a voiding and timed accurately. Add 0.5 ml 40% formalin to collection bottle. Urine must be acid. The amount of urine excreted in 1/5 hour is placed in a graduated centrifuge tube and spun for 5 minutes at 1800 rpm. All but 0.5 ml of supernatant is removed with a pipette. The sediment is resuspended and dropped onto a counting chamber. The coverslip is set down on the drop, not slid into place. The number of elements in a large square (0.1 mm^3) x 100,000 equals the daily output.

c. Normal:

	<u>Children</u>	<u>Newborns, 0-6 days</u>
RBC	1,000,000/d	600,000/d
WBC	2,000,000/d	13,000,000/d
Casts	10,000/d	400,000/d

Ref: Acta Paed. 50:361, 1961.

5. Orthostatic Albuminuria

a. Purpose: This is a fairly common type of proteinuria without renal disease. Since patients with true renal disease may show the same phenomenon, the diagnosis must be made by exclusion if there is (1) no impairment of renal function, (2) no hypertension, (3) no urinary abnormality other than proteinuria or an increased number of casts, at least 90% hyaline.

b. Method:

- 1) No fluids after 6 p.m.
- 2) Empty bladder immediately before retiring and discard this urine.
- 3) Remain flat in bed during night. Any urine voided during night is discarded.
- 4) Collect a voided specimen immediately after waking in bed in the morning. Label #1.
- 5) Drink 2 glasses of water. Stand erect and quietly for 20 minutes, then void and label #2.
- 6) Kneel on a chair for 20 minutes with the back arched backward as much as possible. Then void and label #3.
- 7) Walk about actively for 30 minutes, then void and label #4.

For each specimen record the specific gravity and the protein content, by the heat and acetic acid, sulfosalicylic or other simple test.

In orthostatic albuminuria urine excreted in recumbent position contains no albumin. Urine excreted in upright or lordotic positions contains variable amounts of albumin.

6. Urine Acidification Test

- a. Purpose: In order to evaluate the renal tubular acidification mechanisms when random urine pH values are greater than 6 in the presence of systemic metabolic acidosis a challenge with ammonium chloride may be required.

b. Method:

- 1) Ammonium chloride 5.5 mEq/kg (150 mEq/m²) is given orally.
- 2) Over the next 5 hours urine pH should be measured every hour if possible.
- 3) Plasma bicarbonate concentration should be measured 3 hours after ingestion of ammonium chloride

- c. Results: The urine pH should fall below 5.5. If urine pH is not lower than 5.5 and the plasma bicarbonate is not below 17 mEq/L, larger doses of ammonium chloride may be necessary to produce a plasma bicarbonate concentration below an abnormal renal bicarbonate reabsorption threshold. Extreme care should be taken when using larger doses of ammonium chloride.

d. Interpretation:

Normal Response

- 1) Fall in plasma bicarbonate concentration
- 2) Fall in urine pH to below 5.5

Renal Tubular Acidosis - Distal Type

- 1) Fall in plasma bicarbonate concentration.
- 2) Urine pH remains above 6.0

Renal Tubular Acidosis - Proximal Type

- 1) Fall in plasma bicarbonate concentration (see above)
- 2) Fall in urine pH below 5.5

Ref: Ped. Res., 1:452, 1967.

CEREBROSPINAL FLUID

CAUTION: Lumbar puncture may be dangerous in the presence of increased intracranial pressure and overlying skin infections, as well as in individuals who have bleeding tendencies.

Prior to lumbar puncture fundiscopic examination should be done. Presence of papilledema calls for extreme caution and may contraindicate lumbar puncture.

Sudden drop in pressure by rapid release of spinal fluid may be fatal in presence of increased pressure.

1. Cerebrospinal Fluid Pressure

The patient should lie quietly on his side with head and lower extremities only gently flexed. Compression of the abdomen should be avoided. If these qualifications are not met, the spinal fluid pressure may be artificially elevated. The manometer should be attached to the needle with care to prevent the loss of fluid, for this will lower the pressure. There should be free flow of fluid, and usually fluctuations are noted with respirations. Several readings should be made and recorded as mm. of cerebrospinal fluid.

Queckenstedt Test:

(SHOULD NOT BE DONE IN PRESENCE OF INCREASED INTRACRANIAL PRESSURE.) Compress first the right and then the left jugular veins. Normally this will produce a rise in intracranial pressure which in turn will be transmitted to the lumbar canal. Failure of spinal fluid pressure to rise indicates either obstruction in the lumbar canal or obstruction in the ipsilateral venous system (acquired or congenital.)

2. Collection of Cerebrospinal Fluid

Collect 3 tubes of spinal fluid under sterile precautions (save a fourth tube if possible for additional studies). The first tube is for culture, the second for chemistry determinations and the third for cell count. About 1-2 ml in each tube will suffice for routine examinations, but cell count and gram stain can be done on less than 1 ml. Larger amounts of fluid should be collected if special studies are contemplated (i.e., guinea pig inoculation, colloidal gold, etc.).

3. Pandy Test

(A qualitative test for increased spinal fluid protein.)

A drop of spinal fluid is allowed to fall into 2 ml of saturated (5%) phenol solution (Pandy solution). DO NOT SHAKE. If protein is

increased, a cloud will form. This is recorded 1 to 4+ depending on the degree of cloudiness. Pandy solution and spinal fluid should be at the same temperature; otherwise, a false positive test may be obtained.

4. Appearance

Record:

- a. Color
- b. Clarity
- c. Presence or absence of pellicle

5. Culture

Spinal fluid culture should be planted as soon as possible. Follow instructions in MICRO-BIOLOGICAL EXAMINATIONS using sterile precautions. Drop CSF directly onto appropriate media and also incubate remaining CSF as original fluid. Time may be saved by placing sensitivity discs on a second set of streaked plates.

6. Cell Count

Unacidified spinal fluid is examined microscopically in the counting chamber. The presence of RBC's and crenation are noted. RBC's should be counted. Then rinse pipette with glacial acetic acid, and allow to stand for 5 minutes. Then count WBC's on all 9 chambers and multiply by 10/9. The pipette may be rinsed with a stain to hemolyze the red cells and accentuate the white cells.

Do not attempt a differential WBC count on the cells in the counting chamber since they are inaccurate.

7. Differential WBC and Cell Morphology

- a. A drop of centrifuged CSF is placed on a slide and caused to run down its length. This forms a thin smear which dries quickly before cell forms are distorted. It can be stained with Wright's stain.
- b. If leukemic meningitis is suspected, or cell morphology is critical, fresh CSF is added to the patient's serum in equal parts immediately, and a stained smear made.

8. Examination for Bacteria

- a. If pellicle forms, it should be fished out, crushed between 2 clean slides and the slides pulled apart, giving 2 smears. One is stained with Gram's stain and the other for acid-fast bacillus.

- b. Uncontaminated CSF is spun, and the sediment is smeared on a slide and Gram stained.
- c. If the Gram stain reveals suspected *H. flu* or pneumococci, a Quellung may be set up.

9. Examination for Fungus

One drop of CSF and 1 drop of either Nigrosin or dilute India Ink are placed on a slide and mixed well. Cover with coverslip and press out excess fluid. Ring with vaseline. Examine for round organisms with large halos. If your index of suspicion for fungi is high you may incubate the preparation at 37° and reexamine at 24 and 48 hours.

10. Chemical Determinations

- a. Sugar:
 - 1) Send stat to chemistry lab, or
 - 2) Freeze for glucose oxidase determination, or
 - 3) Add 0.1 ml of spinal fluid to 1.9 ml phosphotungstic acid and send to chemistry lab at later time.

Rapid semi-quantitative: Place 1.0 ml Benedict's solution in each of 6 Wassermann tubes. Add 0.05, 0.1, 0.15, 0.20, and 0.25 ml of spinal fluid. Tube #6 is a control. Place in boiling water bath for 5 minutes. Reduction (green color) should occur in 2 or 3 tubes.

- b. Protein: Send to chemistry laboratory.

11. Serologic Studies

May be performed in serology laboratory.

SYNOVIAL FLUID

A. EXAMINATION OF SYNOVIAL FLUID

1. Appearance

Note quantity, turbidity, pH, clot formation, viscosity, and icterus.

2. Microscopic

Examine undiluted for total RBC and WBC count and crystals. Dilute with saline to obtain WBC if necessary. The use of acid WBC diluting fluids may produce clotting.

Normal cell count: less than 180 WBC/mm³, with less than 25% polys.

3. Chemical

Obtain sugar and protein determinations. Sugar should be within 10 mg% of blood sugar. Be sure to obtain simultaneous blood sugar.

4. Mucin

To 1 ml synovial fluid from which the cells have been centrifuged, add 4 ml water, then 2-3 drops glacial acetic acid. A tight rope of mucin is normal. In infection and rheumatoid arthritis no precipitate or a loose fibrillar precipitate is formed.

5. Bacteriologic

Gram stain sediment, and culture aerobically, anaerobically, and for AFB.

6. Icterus

May indicate trauma. Sample sent to chemistry lab for bilirubin.

NOTE: A portion of the fluid may be placed in a heparinized tube to prevent clotting.

B. CHARACTERISTICS OF SYNOVIAL FLUIDS IN DISEASE

Etiology	Appearance	Leukocytes/mm ³	Neutrophils(%)	Mucin	*Glucose Difference (mg/100 ml)
Normal	Clear, straw	13-200 (63)	0-25 (6.5)	Good, tight	10 or less
Traumatic	Clear, straw or hemorrhagic	200-5800 (1680)	0-36 (10)	Good, tight	10 or less
Degenerative	Clear, yellow	70-1950 (520)	0-58 (8)	Good, tight	10 or less
Rheumatic fever	Slightly turbid, yellow	1,000-63,000 (10,000)	8-98 (46)	Good, tight	10 or less
Gout	Turbid	1,000-31,000 (10,000)	48-94 (83)	Loose, friable	0-40
Rheumatoid	Clear to turbid, yellow-green	600-66,000 (15,000)	5-96 (65)	Loose, friable	0-30
Tuberculosis	Turbid, yellow	2,500-105,000 (25,000)	29-96 (67)	Loose, friable	0-108 (57)
Gonorrheal	Turbid, yellow	1,500-108,000 (15,000)	2-96 (65)	Loose, friable	0-97 (26)
Septic	Very turbid	25,000-200,000 (65,000)	75-100 (95)	Loose, friable	50-120 (70)

*Refers to difference between glucose concentration in joint fluid and fasting blood sugar.

MICROBIOLOGICAL
EXAMINATIONS

A. EXAMINATION OF FRESH PREPARATIONS AND STAINED SMEARS

1. Staining Techniques

- a. Gram Stain (Rapid Method):
 - 1) Flood slide with gentian violet -- 15 seconds.
 - 2) Wash, add Gram's iodine -- leave 20 seconds, decolorize with acetone alcohol -- 5 seconds.
 - 3) Wash with water.
 - 4) Counterstain with safranin -- 15 seconds.
- b. Acid Fast Stain:
 - 1) Flood slide with Kenyon's stain -- 5 minutes.
 - 2) Decolorize with acid alcohol until faint pink.
 - 3) Counterstain with 1/2% methylene blue -- 1 minute.
- c. India Ink (Nigrosin's Stain):

A negative stain used mainly for identification of *Cryptococcus*. India Ink must be quite dilute. One drop of test fluid and one drop of India Ink are mixed well and examined for presence of organism identified as a refractile image against a black background.

B. CULTURE METHODS

1. The Following Material Should Be Cultured Immediately:

- a. Blood:
 - 1) Approximately 2 ml blood into thioglycolate media.
 - 2) Approximately 8 ml blood into screw-capped bottle of infusion broth.

NOTE: If patient is being treated with penicillin, use 0.2 + 0.5 ml of penicillinase respectively in each. Also culture the penicillinase in thioglycolate as a control for contamination.

- b. CSF:
 - 1) Chocolate agar (place in CO₂ jar).
 - 2) Human blood agar.
 - 3) Desoxycholate agar.
 - 4) Thioglycolate.
 - 5) Original fluid.

- c. Urine:
 - 1) One loopful (special loop) per plate.
 - 2) Human blood agar.
 - 3) Desoxycholate agar plate.
 - 4) Incubate.
- d. Cavity Fluids:
 - 1) Culture the same as CSF fluid.
 - 2) Peritoneal and abscess cultures should be taken directly to lab for special anaerobic cultures.

2. All Other Specimens:

Throat, Ear, NP, Eye, Skin (wound abscess), Stool (rectal swabs): Place swab in transfer media and refrigerate.

3. To expedite cultures (evenings and weekends) the house officer may use the following:

- a. NP, Eye and Ear:
 - 1) Human blood agar.
 - 2) Desoxycholate agar.
 - 3) Chocolate blood agar.
 - 4) Swab in transport media.
- b. Throat:
 - 1) Human blood agar.
 - 2) Desoxycholate agar.
 - 3) Swab in transport media.
- c. Vagina and Urethra:
 - 1) Thayer-Martin agar
 - 2) Human blood agar.
 - 3) Chocolate blood agar.
 - 4) Thioglycolate broth.

NOTE: Always culture immediately and always do gram stain as well.
- d. Skin:
 - 1) Human blood agar.
 - 2) Desoxycholate agar.
 - 3) Inoculate thioglycolate.

NOTE: The house officer may elect to place sensitivity discs on the plates of cultures from those patients in whom a rapid answer is critical.

4. Fungus Preparation

Edges of a lesion suspected of having fungus in it may be scraped with a scalpel onto a glass slide. The scrapings are covered with 10% to 20% KOH or NaOH and a coverslip applied. Warm over light globe for a few minutes. Examine for fragments of mycelia and spores.

STOOL EXAMINATION

1. Parasitology Preparations - See next page for illustrations.

- a. Direct Smear: Add small amount of feces to drop of saline, mix and remove feces with applicator stick. Cover. Examine under low power to locate the parasite and high dry for identification. Species identification of protozoan cysts can be made by adding iodine stain (KI 1.0% saturated with crystalline iodine) to smear, or by making an additional prep in a drop of stain.
- b. Zinc Sulfate or Sucrose Concentration Flotation Method:
 - 1) Add water to a small amount of stool. Mix with tongue depressor.
 - 2) Strain through cheese cloth.
 - 3) Add water, mix, and centrifuge for 1 min. Pour off supernatant.
 - 4) Add zinc sulfate solution, s.g. 1.18 or saturated sucrose solution and mix well. Centrifuge 1 minute.
 - 5) Transfer surface material with a wire loop to slide. Examine for ova.

2. Examination for Pinworms

- a. Parents inspect perianal area at night about an hour after the child retires, looking for thread-like white worms (1/4 to 1/2 inch).
- b. Pinworm Smear: Cellophane Tape Method
 - 1) ~~Smear~~ Smear in morning before bath.
 - 2) Cover one end of a tongue depressor with cellophane tape, sticky side out.
 - 3) Apply to perianal area with mild pressure.
 - 4) Put 1 drop xylol on glass, then apply tape to slide.
 - 5) Look for ova under microscope.
- c. Examination of Stool after Purgative and Enema.

3. Test for Occult Blood in Stool (Guaiac Method)

Reagents:

Gum guaiac
 Glacial acetic acid
 Hydrogen peroxide (fresh)

- 1) Method #1: Make thin smear of stool on filter paper. Serially apply 2 drops of each in this order: acetic acid, guaiac, hydrogen peroxide. A blue color is positive; green is not.
- 2) Method #2: Dilute stool in equal part of water. Centrifuge or filter. Acidify a few ml of freshly prepared tincture of guaiac with glacial acetic acid. Add equal volume of hydrogen peroxide and shake.

DIFFERENTIAL CHARACTERISTICS OF IMPORTANT HUMAN ROUNDWORM OVA

Ascaris lumbricoides

Infertile Egg

Fertile Eggs



Surface View



Optical Section



Trichuris trichiura



Red Blood Cells at same Magnification as ova ... for size comparison



Enterobius vermicularis



Stages of Development of Necator americanus or Ancylostoma doudenale



Strongyloides stercoralis



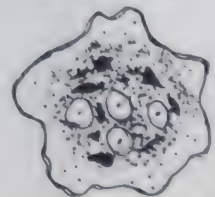
PROTOZOA

Giardia



Cyst

Entamoeba histolytica



Trophozoite

Margaret Showers 1972

Pour an equal amount of this reagent over the stool dilution. A blue color will form if positive. Several minutes should be allowed.

4. Apt Test for Fetal Hemoglobin

- a. Method: Mix specimen (stool, vomitus, etc.) with an equal quantity of tap water. Centrifuge or filter. Supernatant must have pink color to proceed. To 5 parts of supernatant, add 1 part of 0.25% NaOH.
- b. Interpretation: A pink color persisting over 2 minutes indicates fetal hemoglobin. Adult hemoglobin gives a pink color that becomes yellow in 2 minutes or less.

Ref: J. Pediat. 47:6, 1955.

5. TCA Test for Protein in Meconium

- a. Method: Mix meconium with 2 to 8 ml of water. Allow to stand at room temperature for 1 hour and then centrifuge. Filter supernatant. Mix 0.25 ml of filtered supernatant with 0.25 ml of 20% TCA.
- b. Interpretation: If original meconium contains protein a voluminous precipitate is formed. In patients with meconium ileus this strongly suggests pancreatic insufficiency.

Ref: Peds., 21:635, 1958.

6. Farber Meconium Test

- a. Purpose: Helpful in diagnosing intestinal atresia of newborn.
- b. Method: Thin smear of meconium is made using central portion of the specimen to avoid contamination by epithelial cells from the anal area. Place slide in ether for 5 minutes and then allow to dry. Stain for 1 minute with Sterling's gentian violet (5 gm gentian violet, 10 ml 95% alcohol, 2 ml aniline dye, 88 ml water). Wash slide in H₂O, decolorize with acid alcohol and dry.
- c. Interpretation: In cases of intestinal atresia the contents of the amniotic sac are absent from meconium. Normally, cornified epithelial cells (large thin scales without nuclei) are abundant in meconium.

7. Stool Gelatinase (Trypsin) Activity

- a. Purpose: Infants and young children (less than 4 years) normally have measurable gelatinase activity in their stools. This is mostly contributed by the pancreas although small and usually insignificant amounts are added by some bacteria. Low amounts found

in constipation, marasmus, pancreatic insufficiency and pancreatic duct obstruction.

b. Method:

- 1) To 4 ml of water, add enough stool to bring the total volume to 5 ml (1:5 dilution). Mix well and centrifuge. Run a control stool in a similar way.
- 2) Make 1:10 dilution by adding 1 ml of supernatant to 1 ml of water. Make 1:50, 1:100, 1:200 dilutions in a similar way.
- 3) Cut undeveloped x-ray film into long narrow strips and insert each into long test tubes containing the dilutions.
- 4) Incubate at 37°C for 1 hour.
- 5) Record the highest dilution that digests the gelatin from the film.

c. Interpretation: The normal child has a titer of 1:100 or greater. A control stool should always be run. Some children with partial pancreatic insufficiency may have occasional stools with normal amounts due to maximal stimulation of remaining pancreatic tissue from the ingestion of food. Therefore, low titers are more significant than high ones.

8. Microscopic Stool Fat Test

A drop of stool and 2 drops of 1% scarlet red in absolute alcohol (or Sudan IV) are mixed on a slide and mixed with 1 drop of saline. A cover-slip is placed over the slide. The fat present may appear as round droplets stained red, or as clumps of spindle-shaped crystals stained faint orange or not stained at all. An excessive number of fat droplets or crystals is characteristic of any form of steatorrhea.

Ref: Am. J. Dis. Child. 69:141, 1945.

9. Microscopic Stool Starch Test

A drop of stool not more than a few hours old is mixed on a slide with 1 drop of normal ammonium chloride, and then with 1 drop of 3.5% solution of iodine in 5% potassium iodide. Starch granules stain blue, but the free granules must be distinguished from those enclosed in vegetable cells. Normally, free extracellular granules are not frequent but with defects in starch digestion such granules may be present in large numbers. Intracellular starch granules may be ignored except when they occur in very great numbers.

10. Test for Sugar in Stool

- a. Purpose: Detection of carbohydrate malabsorption by measuring reducing substances in stool. Since sucrose is not a reducing substance modify test as noted.

b. Method:

- 1) Place a small amount of fresh liquid stool in a test tube.
- 2) Dilute with twice its volume of water. For sucrose use 1N HCl instead of water and boil briefly.
- 3) Place 15 drops of this suspension in 2nd test tube containing a Clinitest tablet.
- 4) Compare the resulting color with the chart provided for urine testing.

- c. Interpretation: Normally one finds 0.25% or less reducing substances in the stool. Values of 0.25% to 0.5% are questionable. The finding of 0.5% or greater reducing substances in the stool is abnormal and suggests carbohydrate malabsorption.

11. Stool Urobilin

- a. Theory: "Direct acting" (conjugated) bilirubin in the bowel is reduced by bacterial action to urobilinogen (stercobilinogen) which is in turn oxidized to yellow-orange urobilin (stercobilin). An approximate determination of these can be made as follows:

b. Reagents:

- 1) Saturated alcoholic solution of zinc acetate (Schlesinger's Reagent): Mix 5 gm zinc acetate with 100 ml 95% alcohol in a water bath at 50°C. Crystals should form in bottle when cooled.
- 2) Saturated aqueous solution of sodium acetate: Place 100 gm sodium acetate in a 100 ml flask, add distilled water to mark. Heat to 60°C. Mix. Crystals should form in bottle when cooled, and should be present when solution is used.
- 3) Ehrlich's aldehyde reagent.

- c. Method: Use fresh stool. (Urobilinogen is oxidized by room air to urobilin.) Emulsify 2 gm of stool (about the size of a small marble) in 10 ml saturated alcoholic solution of zinc acetate. Filter. Examine a sample of filtrate in a narrow beam of transmitted light (as from a pen light) for green fluorescence. This is a rough measure of urobilin. Mix 2.5 ml of clear filtrate with 2.5 ml Ehrlich's aldehyde reagent. In exactly 15 seconds add 5 ml saturated aqueous solution of sodium acetate. Mix. A pink color indicates urobilinogen. Compare with normal stool and grade as normal, increased, or decreased.

M E T A B O L I C T E S T S

A. TOLERANCE TESTS

1. Oral Glucose Tolerance Test

- a. Purpose: To test both GI absorption and body metabolism of glucose.
- b. Method:

0-18 months	-	2.5 gm/kg
1-1/2-3 years	-	2.0 gm/kg
3-12 years	-	1.75 gm/kg
>12 years	-	1.25 gm/kg

For all, minimum of 10 gm and maximum of 50 gm.

Mix glucose with water and lemon juice as a 20 per cent solution. If not taken well, gavage.

- c. Specimens: Capillary or venous blood. Source should be consistent throughout a single test.
- d. Time: 0 minutes, 1/2 hour, 1 hour, 2 hours, 3 hours. (Add 4 and 5 hour specimens when evaluating hypoglycemia.)
- e. Urine: Collect at 0, 1 and 2 hours and analyze for sugar.
- f. Normal: Peak at 1/2-1 hour. Often at or near fasting level at 2 hours.

Normal Values When Total Reducing
Substance Measured Using Capillary Blood

Time:	0	1/2 hr	1 hr	2 hr	3 hr	4 hr	5 hr
Mg% :	101 $\pm$ 3	162 $\pm$ 9	131 $\pm$ 7	108 $\pm$ 6	91 $\pm$ 5	91 $\pm$ 3	94 $\pm$ 3

The above values are based on capillary blood which was quickly lysed with distilled water and precipitated with tungstic acid.

2. IV Glucose Tolerance Test

- a. Purpose: Obviates problems of absorption found in oral test.
- b. Method: Glucose 0.5 gm/kg in a 20-50% solution is given over 2 to 4 minutes.
- c. Specimens: Time 0 minutes, 5 minutes, 15 minutes, 30 minutes, 45 minutes, and 60 minutes.
- d. Urine: collect before and at end of test.
- e. Normal: Peak value comes at 5 minutes and normal should be attained at 45-60 minutes.

3. Epinephrine Tolerance Test

- a. Purpose: To test for presence of avail-

able glycogen stores in the liver.

- b. Method: Epinephrine HCl (1:1,000) 0.03 cc/kg but not above 0.5 cc is given SC.
- c. Specimens: Blood sugar samples are drawn at 0, 1/2 hour, 1 hour and 2 hours.
- d. Normal: The fasting level should double in the normal after 1 hour.

4. Glucagon Tolerance Test

- a. Purpose: Glucagon raises blood sugar by increasing glycogen breakdown in the liver by activating liver phosphorylase. No effect on muscle phosphorylase.
- b. Method: 8 hour fast. Give glucagon IV or SC 20 micrograms/kg.
- c. Specimens: 0, 10, 20, 30, 40, 60, 90, and 120 minutes.
- d. Normal: Normally blood sugar rises 40-60% in 10 to 20 minutes.

5. Galactose Tolerance Test

- a. Purpose: This is used to distinguish type I glycogen storage disease (glucose-6-phosphatase deficiency). It should not be used in galactosemia.
- b. Method: Galactose 1 gm/kg is administered orally as a 20% solution over 3 minutes.
- c. Specimens: 0, 5, 15, 30, 45 minutes.

6. IV Galactose Tolerance Test

- a. Method: 1 gm/kg IV over 3 minutes.
- b. Specimens: 0, 10, 20, 30, 45 and 60 minutes.
- c. Normal: There should be a rise in blood glucose levels after the administration of galactose. No rise would suggest type I glycogen storage disease.

Ref: Pediat. 19:585, 1957.

The Metabolic Basis of Inherited Disease, edited by Stanbury.

7. Fructose Tolerance Test

(May also be useful in diagnosis of glucose-6-phosphatase deficiency.)

Method: 0.5 gm/kg PO or 0.25 gm/kg IV. The fructose should normally be rapidly converted to glucose with a rise in blood glucose.

Fructose Tolerance Test in Diagnosis of

Hereditary Fructose Intolerance: Give fructose 0.25 gm/kg in adult or 3 gm/m² surface area in children by rapid IV drip. In this entity there is a marked and prolonged fall of both true blood glucose and serum

inorganic phosphate. The fall in serum phosphate precedes that of glucose and may be the only sign when too small a dose of fructose is administered.

8. Sodium Tolbutamide Tolerance Test

- a. Purpose: To detect insulin-secreting tumor.
- b. Method: High carbohydrate diet for at least 3 days. Sodium tolbutamide 25 mg/kg in 10 ml distilled water is administered IV over 2 minute period, or 25 gm/kg PO.
- c. Specimens: 0, 15, 30, 60 minutes; 1-1/2 hours, 2 hours, 3 hours.
- d. Results: Marked rapid decrease in sugar without return in less than 3 hours in presence of pancreatic adenoma. Of greatest value in patients with fasting blood sugar near normal range.

NOTE: Terminate test with 50% glucose if severe symptoms develop. This is a non-specific test in the pediatric population. Frequently positive in various types of hypoglycemia. It is not specific for insulinoma in children.

9. Leucine Tolerance Test

- a. Purpose: To detect hypoglycemia secondary to leucine ingestion.
- b. Method: Leucine, 150 mg/kg is given orally over 2-5 minutes to a fasting patient. Blood glucose or reducing substance is measured. May use 75-100 mg/kg IV.
- c. Specimens: 0, 15, 30, 45, 60 and 90 minutes.
- d. Normal: No change in sugar level should result. In the sensitive patient, blood sugar will drop to 50% of the control in 30 to 45 minutes.

NOTE: Special circumstances may require gelatin or casein tolerance tests.

Ref: J. Clin. Invest. 35:411, 1956.

10. Tryptophane Load Test

- a. Purpose: Tryptophane loading is used to look for two pediatric diseases: 1) with pyridoxine deficiency, the patient spills xanthurenic acid in the urine; 2) in Hartnup's disease, indican is spilled in the urine in larger amounts and over a longer period than normal.

b. Method:

- 1) Tryptophane 70 mgm/kg is given orally.
- 2) A 24 hour urine is collected for xanthurenic acid. Urine should be in brown glass, cold, and under 20 cc of toluene.
- 3) Urine is collected at 6, 12, and 24 hours and tested for indican.

Test for Indicanuria:

Reagent: 2 gm FeCl_3 in 1 liter concentrated HCl. Test: Remove bile with 10% BaCl_2 and filter. Add 5 ml reagent to 4 ml urine or filtrate. Mix, then add 2-3 ml chloroform. Invert several times. A blue color in the chloroform indicates the presence of indican (indoxyl sulfate).

Ref: Biochemical Journal 72:301, 1957.

11. Creatine Tolerance Test

Patient is placed on a creatine-free diet (i.e., free of meat, fish, poultry). After 2 days a 24 hour urine specimen is obtained. Patient is then given 1.32 gm creatine hydrate PO (equivalent to 1.0 gm anhydrous creatine). A second 24 hour urine specimen is obtained. Total creatine is measured in each of the 2 specimens. The normal creatinuria of the first specimen is subtracted from the creatine of the second specimen to give the amount of ingested creatine excreted; this is then subtracted from 1.0 gm and the per cent of creatine retained calculated.

For small infants use 1/2 the amount of creatine; for large adolescents, twice the amount.

Normal Values (percent retained)

Infants:	35-45% (average 40%)
Children:	30-70% (average 50%)
Adults:	More than 70%

The per cent retained is reduced in muscular dystrophy, hyperthyroidism, and wasting disease.

Ref: Am. J. Dis. Child. 51:30, 1936.
Endocrinology 21:773, 1937.
Arch. Neur. & Psych. 38:992, 1937.

12. Phenylalanine Tolerance Test

- a. Purpose: The detection of heterozygous carriers of the recessive gene for phenylketonuria.
- b. Method: 0.1 gm/kg of body weight of L-phenylalanine is given by mouth. Blood

samples are obtained at 1, 2, and 4 hours after the initial dose, and the plasma phenylalanine level is determined. Carriers show a definite increase in plasma phenylalanine as compared with normal controls.

Ref: Nature 178:1239, 1956.

B. QUICK METHOD FOR PLASMA GLUCOSE

Fill a heparinized microhematocrit tube with capillary blood and centrifuge it. Using a microbulb, place 1 drop of the plasma on the Dextrostix. Allow to stand for 3 minutes. Wash off with 0.2 N (20%) sodium hydroxide and permit to dry. No change in color indicates less than 20 mg/100 ml; faint orange, 20 to 30 mg/100 ml; deep orange, greater than 40 mg/100 ml. A standard curve can be prepared by using plasma of known glucose concentrations. This value is an estimate and must be verified by a reliable laboratory method.

Ref: Pediat. Clin. N. Amer. 13:907, 1966.

C. MISCELLANEOUS METABOLIC TESTS

1. The Ferric Chloride Reaction

- a. Principle: Certain compounds react with Fe^{+++} to form colored derivatives (see chart on next page). Phosphate ions, which could artifactually produce a negative result are removed by precipitation as MgNH_4PO_4 . Therefore, we suggest the optimal method which follows:
- b. Reagents: Ferric chloride reagent: Dissolve 1.0 gram ferric chloride ($\text{FeCl}_3 \cdot 6\text{H}_2\text{O}$) and 1 gram ferrous ammonium sulfate [$\text{Fe}(\text{NH}_4)_2(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$] in 100 ml 0.02N HCl. Can store at room temperature. Should be labeled Perry's FeCl_3 reagent.
- c. Procedure:
 - 1) 1 ml FeCl_3 reagent in clean test tube;
 - 2) 10 drops (0.5 ml) urine, mixed well by shaking;
 - 3) Observe color;
 - 4) Disregard color appearing later than 10-20 seconds.
- d. Interpretation: See table on the interpretation of the ferric chloride reaction on next page.

2. Semi-Quantitative Test for Calcium in Urine

Sulkowitch Test

- a. Method: To 5 ml of urine in a test tube add about 2 ml of Sulkowitch solution.

INTERPRETATION OF THE FERRIC CHLORIDE REACTION

Materials Giving Positive FeCl ₃ Reaction	Clinical Condition In Which Present	Color Produced
Phenylpyruvic Acid	Phenylketonuria	Green fading over hours
Imidazolepyruvic Acid	Histidinemia	Brown-green, stable
p-Hydroxyphenylpyruvic Acid	Tyrosinosis	Green; fades in seconds
Branched-Chain Keto Acids	Maple Syrup Urine Disease	Blue-black; present for several hours
Homogentisic Acid	Alkaptonuria	Blue-green; fades quickly
Acetoacetic Acid	Ketosis	Red-purple; becomes negative after heating urine
Salicylates	Salicylate Ingestion	Stable purple; might be negative if urine is <u>strongly</u> acidified
Phenothiazine Derivatives	Compazine & Thorazine Ingestion	Blue-purple
p-Aminosalicylic Acid (PAS)	PAS Ingestion	Red-brown
Phosphates, Other Anions	Normal Urines	White to brown; precipitates which <u>can</u> obscure positive test
Lysol	Lysol Ingestion	Green
Antipyrine and Acetophenetidines	Antipyrine & Acetophenetidine Ingestion	Cherry red
Bilirubin	Hepatitis or Other Conditions with Increased Direct Reacting Bilirubin	Green; moderately stable

Compare resulting precipitate with the opacity of a control (5 ml of test urine and 2 ml water). Note speed (3 to 30 seconds) of appearance and degree of density of solution. Results are recorded as 0, or 1, 2, 3, or 4+.

Sulkowitch Solution

Oxalic acid	2.5 gm
Ammonium oxalate	2.5 gm
Glacial acetic acid	5.0 ml
Distilled water qs	150.0 ml

- b. Interpretation: Zero test usually indicates hypocalcemia (less than 7.5 mg%); 3-4+ test somewhat suggest hypercalcemia (more than 11 mg%). Certain factors other than disease influence calcium concentration in the urine, including specific gravity of the urine, dietary calcium, and activity of the patient. Test is of special value in differentiating alkalotic from hypocalcemic tetany, in diagnosing hypo- and hyperparathyroidism, and in managing vitamin D dosage in refractory rickets and hypoparathyroidism.

Ref: Parathyroid Glands and Metabolic Bone Disease. Albright, F. and Reifstein, E. C., Jr. Baltimore: Williams and Wilkins, 1948.

3. Paper Spot Test for the Detection of Acid Mucopolysaccharides in the Urine

- a. Purpose: Screening test for the mucopolysaccharidoses (e.g., Hunter, Hurler Syndromes). A few false negatives and false positives have been described.
- b. Method: 5, 10, and 25 microliters of fresh urine are placed on separate spots on a piece of Whatman No. 1 filter paper. (Note: Old urine, especially if infected, will give false negatives.) A micro-pipette should be used to add 5 microliters at a time. Each application should be thoroughly dry before the next is made. The paper is then dipped in an aqueous solution of 0.04% toluidine blue (buffered at pH 2.0 with Coleman's buffer tablets) for 1 minute using a petri dish, drained, and rinsed in 95% ethyl alcohol.
- c. Interpretation: A positive test is read as a purple spot against a light blue background. Normal urines will sometimes give a faint rim of metachromatic material around a blue spot.

4. Porphyrinuria (Uroporphyrin and Coproporphyrin)

a. Method

- 1) Acidify 5 ml of freshly voided urine with a few drops of glacial acetic acid to pH4. Cap with thumb and shake vigorously to expel all CO₂.
- 2) Add 15 ml of peroxide free ether (fresh anesthesia ether is preferable), cap firmly with thumb and shake vigorously for 30 seconds. Pressure must be maintained with thumb until ether and urine layers separate.
- 3) Transfer ether layer to a clean tube and add 5 ml of 1.5 N HCl. Then add 0.25 ml of 0.1% iodine in 95% alcohol and shake vigorously for 30 seconds as in step 2.
- 4) View original aqueous layer (Tube 1) and HCl layer (Tube 2) with a Wood's Lamp for the presence of fluorescence in a totally darkened room.

b. Interpretation:

- 1) Uroporphorins are ether-insoluble, and cause fluorescence in aqueous fraction of tube 1. They are never present in normal urine. Marked uroporphyrinuria occurs almost exclusively in congenital acute and "chronic" forms of porphyria where coproporphyrins are usually increased also. A positive result can usually be predicted by the red color of the urine prior to the testing. If test for porphobilinogen is also positive, the condition is probably acute hepatic porphyria.
- 2) Coproporphyrins cause fluorescence in the HCl layer of tube 2.

Traces of coproporphyrins are present in normal urine, usually in amounts too small to give a strongly positive reaction. Coproporphyrinuria without uroporphyrinuria occurs in conditions associated with:

- a) Increased hematopoietic activity; sickle cell and other hemolytic anemias, pernicious anemia after treatment, hemorrhage, etc.
- b) Hepatic insufficiency: infectious hepatitis, atresia or obstruction of biliary system, cirrhosis, etc.
- c) Toxic interference with hemoglobin synthesized (lead, arsenic, mercury intoxication, etc.)
- d) Miscellaneous: poliomyelitis (particularly bulbar), rheumatic fever, acute and severe febrile illnesses, methemoglobinemia, carbon monoxide poisoning, and

idiopathic coproporphyrinuria.

A strongly positive test in HCl is almost indicative of acute lead poisoning, although it may be seen also in hepatitis. A weakly positive test is seen in minimal or old lead poisoning and in the other conditions mentioned above.

ARBITRARY SCALE OF FLUORESCENCE INTENSITY OF COPROPORPHYRIN SOLUTIONS		
Arbitrary Scale	Color	Approximate Quantitative Equivalent of Coproporphyrin
0	Blue-violet	Less than 0.1 /ml of urine
+	Faint blue- orange	0.1 /ml of urine
++	Blue-orange	0.2 /ml of urine
+++	Orange-red	0.5 /ml of urine
++++	Deep orange- red	More than 0.5 /ml of urine

5. Porphobilinogen (Watson and Schwartz)

- a. Purpose: Found in exacerbation of acute intermittent hepatic porphyria.
- b. Reagents:
 - 1) Ehrlich's reagent (see urobilinogen).
 - 2) Sodium acetate, saturated solution:
100 gm Na acetate
100 ml H₂O
 - 3) Chloroform.
- c. Method:
 - 1) 5 ml of freshly voided urine is added to 5 ml of Ehrlich's aldehyde reagent and shaken for 30 seconds.
 - 2) Saturated aqueous sodium acetate is added to bring to pH of 4-5. If the solution is red at this point then porphobilinogen, urobilinogen or certain indole compounds are present.
 - 3) If any red pigment is present then extraction with 10 ml of chloroform to remove urobilinogen is performed repeatedly until no more red pigment is extracted by the chloroform.
 - 4) If any red pigment remains in the aqueous phase it is extracted with 5 ml of n-butanol. After extraction with the n-butanol any red pigment remaining in the aqueous phase is porphobilinogen.

TESTS OF UPPER GASTROINTESTINAL FUNCTION

1. Augmented Histamine Test

A. Purpose: To aid in the diagnosis of certain hyper or hypoacidity states (e.g. Zollinger-Ellison Syndrome) by measuring the gastric secretion of HCl in a basal state and following stimulation by histamine. The variability of the results in children makes it unreliable in diagnosis of peptic ulcer disease.

B. Method:

- 1) Patients fast beginning at midnight before the test. Infants younger than one year need fast for only 4-6 hours.
- 2) A radio-opaque tube is passed into the stomach and the position of the tube is adjusted under fluroscopy so that the tip is in the pylorus.
- 3) The patient lies on his right side or supine or sits for the remainder of the test.
- 4) Fasting gastric secretion is aspirated and discarded.
- 5) Gastric secretions are then collected by manual suction every 15 minutes for one hour and saved in an iced container. This represents basal secretion.
- 6) Betazol (Histalog, Lilly), 1.0 mg/kg, is injected Sub Q. Minor side reactions may be prevented by prior administration of Diphenhydramine.
- 7) Four 15 minute samples of gastric secretion are again collected and saved in an iced container. This represents post stimulation gastric secretion.
- 8) Each 15 minute sample is measured for pH, volume, and titratable acidity.

C. Normal Values:

Gastroenterology, 52:1101, 1967.
Am. J. Dig. Dis., 14:404, 1969.

2. Semi-Quantitative Analysis of Duodenal Secretions for Activity of Pancreatic Trypsin

A. Duodenal Intubation: Chilled duodenal secretions are collected in the following manner:

- 1) Pass a Levin or similar tube into the stomach. If a weighted tube is used, the weight should have the same diameter as the tube. In larger children a Miller-Abbott tube may be used. If possible a double lumen tube should be used to avoid contamination with gastric contents.

- 2) Position patient on right side and place tube on gravity drainage.
- 3) At intervals of 1/2 to 1 hour check the drainage for color and pH, advancing tube until fluid is bile stained or alkaline.

B. Examination of Duodenal Fluid: Make serial dilutions of the duodenal fluid.

Tube	Duodenal Fluid	5% NaHCO ₃	Final Dilution
1	.64 ml	3.6 ml	1:12-1/2
2	2 ml from tube 1	2 ml	1:25
3	2 ml from tube 2	2 ml	1:50
4	2 ml from tube 3	2 ml	1:100
5	2 ml from tube 4	2 ml	1:200
6	2 ml from tube 5	2 ml	1:400
7	2 ml from tube 6	2 ml	1:800
8	2 ml from tube 7	2 ml	1:1600
9	2 ml from tube 8	2 ml	1:3200
10	none	2 ml	control

Discard 2 ml from tube 9. To each tube add 2 ml of 7-1/2% gelatin. Place tubes in incubator at 37°C for 1 hour, then refrigerate until tube 10 (control) is solid (overnight advised).

Tryptic activity indicated by liquefaction of gelatin persisting after refrigeration.

- C. Interpretation: Normal activity indicated by liquefaction through dilution 1:400 (tubes 1-6 or greater). Borderline activity indicated by liquefaction in tubes 1-5 only (marasmus, etc.). Pancreatic deficiency is suggested by liquefaction in tubes 1-3 only (cystic fibrosis, obstruction of pancreatic duct, etc.).

NOTE: If duodenal juice is contaminated with gastric secretions the test is invalid.

3. Mono and Disaccharide Absorption Tests

- A. Purpose: To diagnose intolerance or malabsorption of a specific carbohydrate by measuring the change in blood glucose following an oral dose of the carbohydrate in question.
- B. Method:
 - 1) The patient fasts 4-6 hours prior to test.
 - 2) The test carbohydrate (lactose, sucrose, maltose, glucose, galactose) is given orally or by gastric tube in a dose of 2.0 gm/kg as a 10% solution (maximum dose of 100 gms.). For maltose the dose is 1.0 gm/kg.

- 3) Serum glucose is measured prior to the carbohydrate dose and at 15, 30, 60, and 90 minutes following the dose.
- 4) The number and character of the stools, the stool pH, and the results of a clinitest determination for reducing substances should be noted on all stools passed during the test and for 8 hours after the test is completed.

C. Interpretation:

- 1) A rise in the blood glucose level of 25 mg/100 ml over the fasting level within the test period is considered normal. An increase of 20 to 25 mg/100 ml is questionable. Increases of less than 20 mg/100 ml are abnormal and suggest malabsorption of the test carbohydrate.
- 2) Malabsorption is also suggested if during the test or subsequent 8 hour period one notes:
 1. The onset of diarrhea
 2. Stool pH of 6.0 or less
 3. Greater than 0.25% reducing substances (Clinitest) in the stool. Note: Sucrose is not a reducing substance.
 4. Crampy abdominal pain or abdominal distention.

4. D-Xylose Test

A. Purpose: To evaluate the integrity of the duodenojejunal intestinal mucosa by measuring the absorption of an oral dose of D-Xylose. Either the elevation in serum concentration or the % urinary excretion of xylose may be used to quantitate D-xylose absorption. Absorption is independent of bile salts, pancreatic exocrine secretions, and intestinal mucosal disaccharidases. The test is unreliable in patients with edema, renal disease, delayed gastric emptying and severe diarrhea.

B. Method:

- 1) Preparation- older children fast for 8 hours prior to the test; younger infants need fast for only 4-6 hours.
- 2) Test Dose - D-Xylose in a dose of 0.5 gm/kg (with a maximum of 5 grams) in a 5% water solution is given orally or via a gastric tube. Placement in the duodenum minimizes error caused by delayed gastric emptying.
- 3) Measurement of Urinary Excretion - patient voids and all urine for 5 hours is collected. Adequate urine flow is insured by supplementary oral or IV fluid. The quantity of xylose is determined colorimetrically.

Normal Values: 5 hour urinary excretion of 25% or greater of the administered dose is normal for children over 6 months. Values between 15 and 25% are questionable. Urinary excretion of less than 15% is abnormal. In infants less than 6 months values below 10% are considered abnormal.

- 4) Measurement of Serum Concentration - Serum samples for determination of xylose concentration are obtained in fasting state and at 30, 60, 90 and 120 minutes following the xylose dose.

Normal Values: A normal response is associated with a serum level exceeding 20 mg/100 ml in any of the post absorptive specimens.

Ref: New Eng. J. Med., 268:1441, 1963.
 Pediat., 48:59, 1971.
 JAMA, 186:517, 1963.

5. Quantitative Fecal Fat

- A. Purpose: Quantitative Determination of fecal fat excretion to aid in diagnosis or management of the fat malabsorption syndromes.

B. Method:

- 1) The patient is given a diet with a relatively constant percentage of fat for 3 days prior to the collection period. Regular ward diets containing approximately 35% of calories as fat are adequate.
- 2) A charcoal marker (3 tablets for children under 6 years and 6 tablets for those over 6 years of age) is given at the beginning of the collection period and again 72 hours later.
- 3) All stools passed from the appearance of the 1st marker until the appearance of the 2nd marker should be saved in a pre-weighted can and refrigerated. Note: In patients with diarrhea the use of markers is unnecessary. A simple 72 hour time collection is adequate.
- 4) Total fecal fatty acid content is determined.

- C. Interpretation: Normal fecal fat excretion on a diet composed of approximately 35% fat is less than 5 gm/24 hours. Severe anorexia with decreased caloric intake will result in falsely low values so that the percentage fecal excretion of fat will be a more accurate index of fat malabsorption.

Ref: Pediat., 46:690, 1970.

6. Butterfat Absorption Test

- A. Purpose: A simple rapid screening test for detecting poor fat absorption. Correlates well with quantitative fecal fat studies.
- B. Method: The patient is fasted after midnight and the following morning a test dose of butterfat (0.5 gm/kg) is given as cream. Capillary blood specimens of 0.1 ml of each are obtained in the fasting state (control) and at hourly intervals up to 4 hours following administration of the butterfat. Optical density of the serum is read at 620 mu in a spectrophotometer using micro-cuvettes with a 1 cm light path. Venipuncture specimens may be used if micro-cuvettes are unavailable.
- C. Interpretation: Maximum serum turbidity usually occurs at 3 hours. A normal response is represented by an increase in serum turbidity of more than 0.170 O.D. between the fasting and 3 hour specimens.

TIME	1 hour	2 hours	3 hours	4 hours
▲ O.D.	.090	.125	.185	.125
RANGE	±.015	±.025	±.015	±.025

Ref: Pediat, 34:855, 1963.

7. Bromsulphalein Test

This test should be performed fasting or after a carbohydrate meal since fat in the serum interferes with the estimation of the color. The test is invalid in the presence of marked jaundice.

- A. Procedure:
- 1) Draw control sample.
 - 2) Inject 5 mg/kg of body weight over a 5 minute period. (Caution: BSP in subcutaneous tissue is very irritating.)
 - 3) Draw 45 minute sample from vein other than that used in #2.
 - 4) Serious anaphylactoid reactions have been reported (although rare). A careful allergic history should be obtained.
- B. Normal: First 2 weeks = 25% retention. Then 5% retention or less.

C A R D I O L O G Y

A. CIRCULATION TIME

Many agents may be used, but these two are recommended:

Decholin (older cooperative children)
Fluorescein (infants and younger children)

1. Technique for Decholin

Test Solution: decholin (sodium dehydrocholate 20%). Contraindicated in asthma.

Using 3-5 ml of solution, depending on size of child, inject swiftly into antecubital vein, using No. 20 needle. Circulation time is measured, preferably with stop watch, from beginning of injection to end point, which is determined when child grimaces or complains of bitter taste.

Normal Circulation Time for Decholin

AGE (Years)	MEAN (Seconds)	RANGE (Seconds)
3- 6	10.5	8-12
6- 9	10.4	7.5-15.5
9-12	11.0	7.5-14
12-15	11.9	10-16

Ref: Acta Paed. 38:423-439, 1949.

2. Technique for Fluorescein

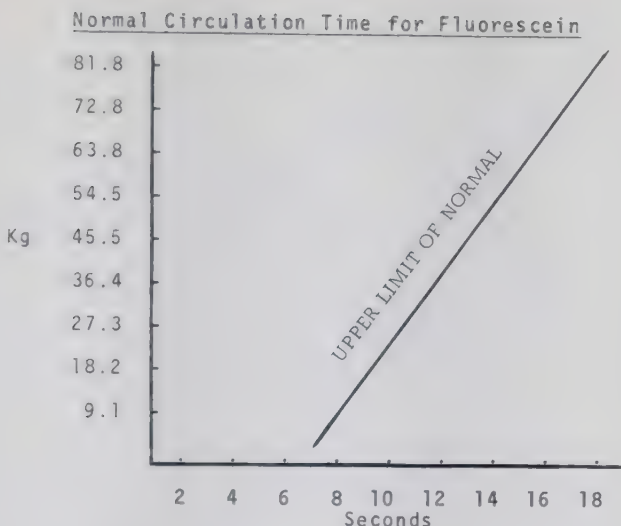
Requires dark room, Wood's light.

Test Solution: fluorescein (fluorescein 5%)

In dark room inject 2 ml 5% solution swiftly into vein (use antecubital if possible; otherwise use wrist or scalp vein). Note when lips, palpebral conjunctivae or face fluoresce. Circulation time measured from beginning of injection until appearance of fluorescence at above sites.

NOTE: One should examine subject's lips for fluorescence before injection. Negro infant's lips normally fluoresce slightly under Wood's light. Patients receiving tetracycline show fluorescence of lips and hence are unsatisfactory subjects.

Normal Circulation Time for Fluorescein
(See figure on next page)

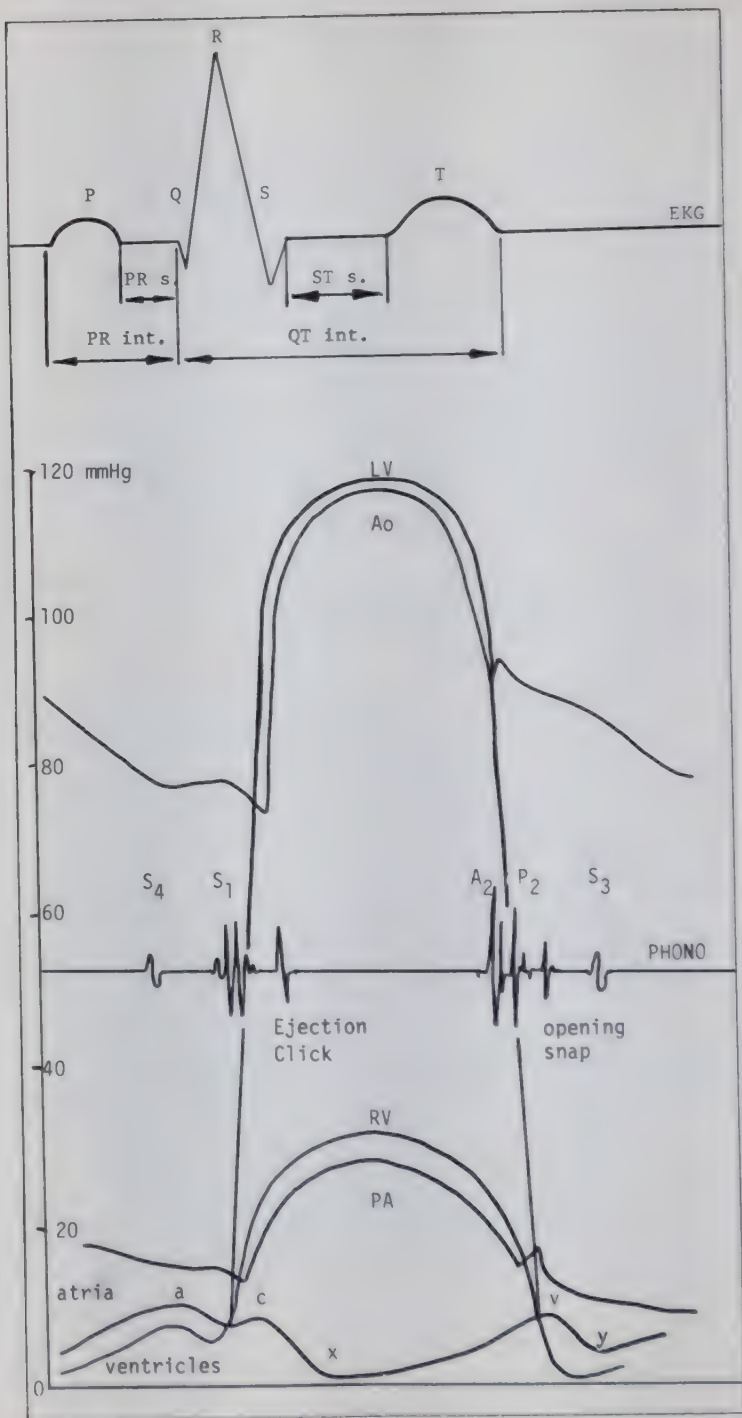


B. CARDIAC CYCLE
(see illustration on next page)

C. ELECTROCARDIOGRAPHY

1. Terminology (see illustration on next page)

The P wave is the result of atrial depolarization. The QRS complex is the result of ventricular depolarization. Within this complex the Q wave is the initial negative wave, the R wave the first positive wave, and the S wave a negative wave following the R wave. When there is only a negative component to the QRS complex, it is called a QS wave. R' and S' waves refer to a second positive and negative wave following R and S waves, respectively, in the same QRS complex. ST segment refers to that segment between the end of the QRS complex and the beginning of the T wave. The T wave is due to ventricular repolarization, which creates a constant wave following the QRS complex, usually of lower amplitude and longer duration. The U wave is a small wave occasionally seen following the T wave. U waves may be noted in electrocardiograms of normal adolescents or in individuals having hypokalemia. The PR interval is measured from the beginning of the P wave to the beginning of the QRS complex. The QT interval is measured from the beginning of the QRS complex to the end of the T wave.



2. Placement and Meaning of Leads

a. Bipolar Leads:

Lead I: Right Arm - Left Arm
 Lead II: Right Arm - Left Leg
 Lead III: Left Arm - Left Leg

b. Unipolar Leads:

aVR: Right Arm
 aVL: Left Arm
 aVF: Left Foot

c. Precordial Leads:

V1 : 4th RICS at RSB
 V2 : 4th LICS at LSB
 V3 : Halfway between V2 + V4
 V4 : 5th LICS at MCL
 V5 : 5th LICS at AAL
 V6 : 5th LICS at MAL
 V3R : V3 on right chest
 V7 : Posterior axillary line.
 (use if no Q wave found in V6)

3. Rate

Rate may be obtained by multiplying by 20 the number of complexes between two vertical lines (3 seconds) at the top of the strip. If rate is slow or irregular, a more accurate reflection of rate is obtained by multiplying by 10 the number of complexes between three vertical lines (6 seconds). Record atrial and ventricular rates when AV block is present.

Heart Rate at Various Ages

Age	Heart Rate	
	Mean	Range
0-24 hours	145	80-200
1- 7 days	138	100-188
8-30 days	162	125-188
1- 3 months	161	115-215
3- 6 months	149	100-215
6-12 months	147	100-188
1- 3 years	130	80-188
3- 5 years	105	68-150
5- 8 years	102	75-150
8-12 years	88	51-125
12-16 years	83	38-125

Modified from Ziegler, R.F.:
Electrocardiographic Studies in Normal
Infants and Children, Springfield, Ill:
 Charles C. Thomas, 1951.

4. Rhythm

The entire strip should be examined to exclude abnormalities of rhythm.

5. P Waves

a. Atrial Enlargement

1. RAE suggested by spiked "P Pulmonale" type P waves higher than 2.5 mm and best seen in L-2 and aVR ().
2. LAE suggested by plateau or notched "P Mitrale" type P waves longer than 0.08 seconds (.
3. McCruz Index - P/PR segment ratio has been used to indicate atrial enlargement in the absence of A-V block. A ratio less than 1 suggest RAE and greater than 1.6 suggests LAE.
4. Terminal and deep inversion of the P wave in V1-2 suggests LAE especially when the P wave is prolonged (.

b. Atrial Inversion

1. True Dextrocardia: characterized by a P vector oriented to the right, inferior and anterior. The P wave is inverted in L-I and upright in aVR. The left precordial leads have a diminished V6 type progression.
2. Technical Dextrocardia: same as true dextrocardia except precordial leads are normal.

c. Abnormal Rhythm

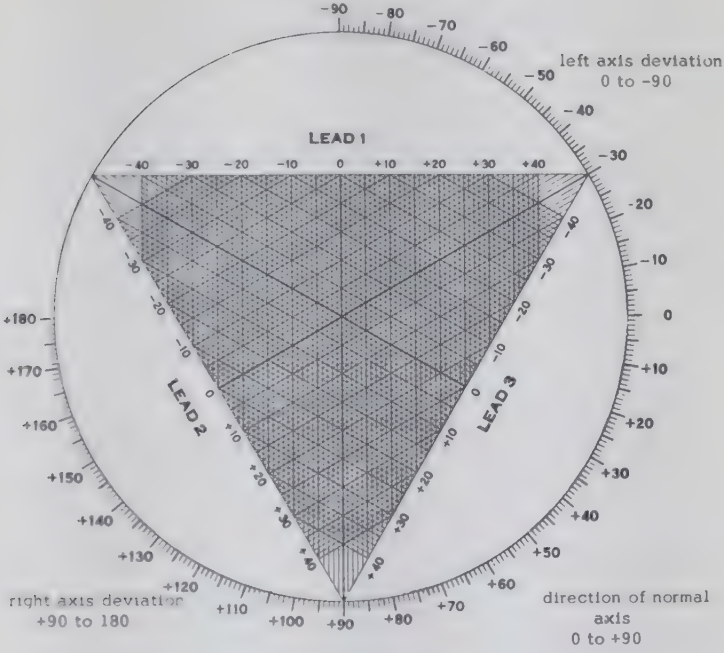
1. Coronary sinus rhythm: shortened to normal PR interval with negative P in L-2, L-3, aVF and upright in V6.
2. Left atrial rhythm: varying P configurations in limb leads depending on site of origin (high, low or mid); however, frequently negative in L-2, L-3, aVF and always negative in V6. Dome and Dart configuration diagnostic of left atrial rhythm with the dome representing left atrium and dart the right atrium. Best seen in L-2 and V1.

6. PR Interval

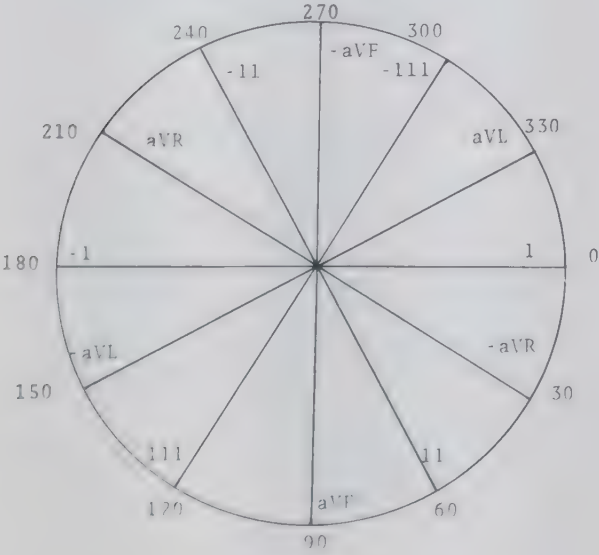
Maximal PR Interval (Longest PR in Any Limb Lead)

	Rate					
Age	-70	71-90	91-110	111-130	131-150	151-
Under 1 month			.11	.11	.11	.11
1-9 months			.14	.13	.12	.11
10-24 months			.15	.14	.14	.10
3-5 years		.16	.16	.16		
6-13 years	.18	.18	.16	.16		

EINTHOVEN TRIANGLE



FRONTAL AXIS



7. QRS Complex

- a. QRS Complex: Measure longest complex in any lead. Relatively independent of age and rate.
- b. Q Wave: qR in V3R or V1, never normal after 24 hours of age. If of sufficient depth and width, may be significant in any lead even in the pediatric age group for ischemia and/or hypertrophy.

8. QRS Axis

See preceding page for calculation of mean electrical axis.

QRS Axis at Various Ages

Age	QRS Axis	
	Mean	Range
0-24 hours	137°	70-205°
1- 7 days	125°	75-185°
8-30 days	108°	30-190°
1- 3 months	75°	25-125°
3- 6 months	65°	30- 96°
6-12 months	65°	10-115°
1- 3 years	55°	6-108°
3- 5 years	62°	20-105°
5- 8 years	65°	16-112°
8-12 years	62°	15-112°
12-16 years	65°	20-116°

Modified from Ziegler, R.F.: Electrocardiographic Studies in Normal Infants and Children, Springfield, Ill.: Charles C. Thomas, 1951.

9. QT IntervalNormal QT Interval

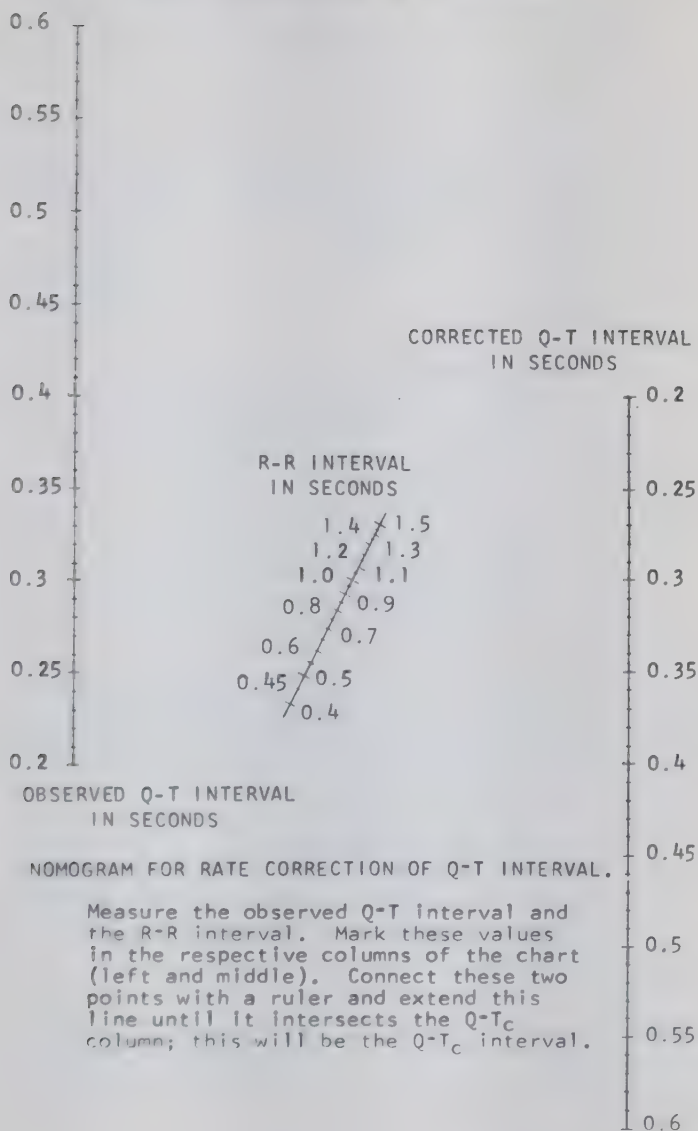
Rate	Mean	+ 2 S.D.
55	.42	.36-.48
65	.39	.34-.44
75	.36	.31-.41
85	.34	.29-.38
95	.32	.27-.36
110	.30	.25-.34
130	.27	.23-.31
160	.25	.21-.28
200	.22	.18-.25

10. QTc (Corrected QT Interval)

$$QTc = \sqrt{\frac{QT \text{ measured}}{\text{cycle length}}} = \text{not greater than } 0.425$$

See next page for Nomogram.

RATE CORRECTION OF Q-T INTERVAL



11. T Wave

Inversion in I: Normal for first 24 hours only. Dextrocardia or myocardial disturbance.

II: Myocardial or pericardial disturbance.

III: Normal.

	T Wave inverted or bi-phasic in over 50% of individuals until age:	May be normal until age:
V1	12 years	17 years
V2	8 years	13 years
V3	3 years	10 years
V4	24 hours	5 years
V5	-	24 hours
V6	-	24 hours

12. Ventricular Hypertrophy

a. Right Ventricular Hypertrophy (any of below, singly or in combination):

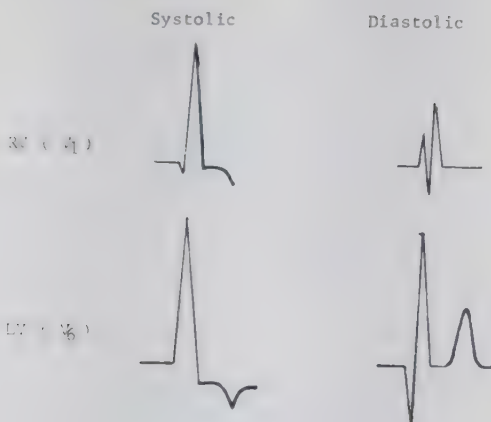
- 1) RV1 $\gt 20$ mm ($\gt 29$ under 1 month)
- 2) SV6 $\gt 7$ mm ($\gt 14$ under 1 month)
- 3) R/S V1 $\gt 2$ after 6 months
- 4) Upright TV1 after 4 days
- 5) qR in V1 or V3R.

b. Left Ventricular Hypertrophy (any of below, singly or in combination):

- 1) RV6 $\gt 25$ mm ($\gt 20$ mm in 1st year)
- 2) SV1 $\gt 20$ mm
- 3) R/S in V1 $\lt 0.8$ under 1 year
 $\lt 0.2$ 1-5 years
 $\lt 0.1$ 6-13 years
- 4) 2° T wave inversion in V5 or V6
- 5) Q $\gt 3$ mm in V5 or V6.

c. Combined Ventricular Hypertrophy:

- 1) Direct signs of right + left
- 2) RVH and
 - a) q 2 mm or more in V6
 - b) sizable RV6
 - c) T inversion in V6
- 3) LVH and
 - a) sizable RV1
 - b) RAD
- 4) "Normal" EKG with cardiomegaly

13. Overload Patterns14. Useful Normal R + S Wave Values

	AGE	R (mm)	S (mm)	R (% R+S)	R/S RATIO	V.A.T. (sec.)
V-1	< 1 MONTH	4-28 (13)	0-15 (6)	40-90 (60)	.66-9.0 (1.2)	.005-.030 (.02)
	< 1 YEAR	1-19 (10)	0-18 (6)	40-80 (50)	.66-4.0 (1.0)	.010-.030 (.02)
	1-8 YRS	1-19 (7)	0-25 (12)	10-60 (35)	.11-1.2 (.54)	.000-.025 (.015)
	8-16 YRS	1-16 (4)	3-24 (15)	10-50 (30)	.11-1.0 (.43)	.000-.030 (.020)
V-2				★ R/S V5 R/S V1		
	< 1 MONTH	7-31 (19)	3-35 (19)	1-6 MONTHS	.2-6	
	< 1 YEAR	7-28 (17)	3-35 (19)	1/2-2 YEARS	.4-8	
	1-8 YRS.	1-31 (14)	7-39 (21)	2-6 YEARS	.5-10	
	8-16 YRS.	1-19 (10)	7-39 (19)	6-10 YEARS	1.0-20	
				10-16 YEARS	1.5-45	
V-5				RVH - BELOW MINIMUM LVH - ABOVE MAXIMUM		
	< 1 MONTH	2-34 (14)	0-18 (6)			.005-.025 (.02)
	< 1 YEAR	6-26 (18)	0-15 (2)			.016-.040 (.025)
	1-8 YRS	10-38 (20)	0-9 (1)			.020-.040 (.030)
	8-16 YRS	6-34 (16)	0-9 (1)			.020-.040 (.035)

15. Bundle Branch Block

- a. Incomplete:
 - 1) Longest QRS < 0.10 when associated with slurred QRS or RSR prime.
- b. Complete: Longest QRS > 0.10
 - 1) LBBB:
 - a) LAD
 - b) R in I tall + late. T in I sharply inverted.
 - c) S in V1 and V2 wide.
 - 2) RBBB:
 - a) RAD
 - b) S in I wide and deep. T in I upright.
 - c) S in V5 and V6 wide.

16. Digitalis

- a. Effect:
 - 1) QTc interval shortened.
 - 2) T waves depressed, then inverted.
 - 3) ST segment depressed.
 - 4) PR interval prolonged.
 - 5) Sinus arrhythmia.
- b. Toxicity:
 - 1) Various degrees of AV block.
 - 2) Bradycardia.
 - 3) Arrhythmias of any type, commonly atrial in children, ventricular in adults.

17. Electrolyte Disturbances

- a. Hyperkalemia: Serial EKG's in an individual can be correlated with serum K^+ .
 - 1) T wave: tall, tented, narrow.
 - 2) PR, QRS, and QT lengthened. QRS may prolong so it blends with T to produce diphasic curve.
 - 3) P wave widened and flattened, finally disappearing.
 - 4) R wave widened and flattened.
 - 5) S wave deepened.
 - 6) Ectopic rhythms and intraventricular block.

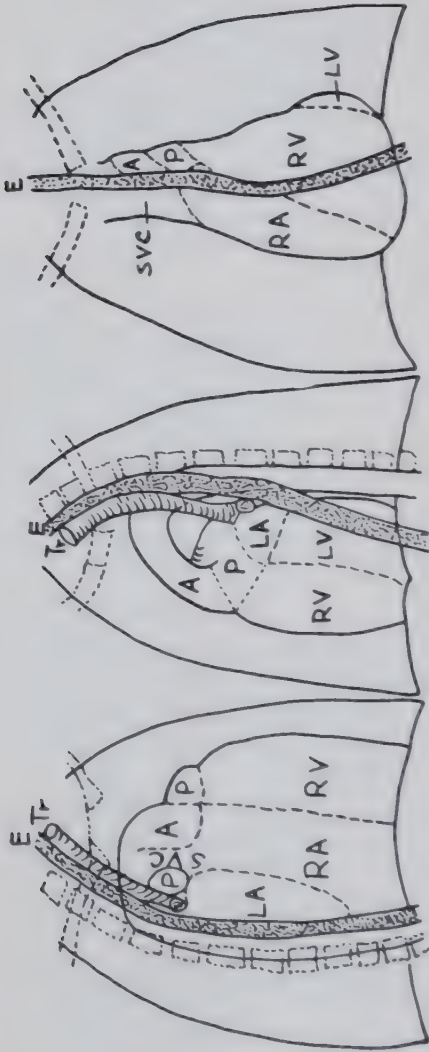
NOTE: These effects are enhanced by Na^+ or Ca^{++} depletion.

- b. Intracellular Potassium Depletion (with intracellular Na^+ excess): Fair correlation with serum K^+ .
 - 1) QT lengthened (due to broad, flat T wave).
 - 2) T wave flattened or inverted.
 - 3) ST segment depressed.
 - 4) U wave prominent.

NOTE: These effects are enhanced by digitalis intoxication. It is probably the ratio of extracellular K/intracellular K that determines EKG changes. Concurrent calcium and sodium changes also play a role.

- c. Hypocalcemia: QT interval lengthened
(due to long ST segment).
- d. Hypercalcemia:
 - 1) QT interval sometimes shortened (due to shortened ST segment).
 - 2) Myocardial irritability increased:
PVCs, ventricular tachycardia.

X-RAY CONTOUR OF HEART

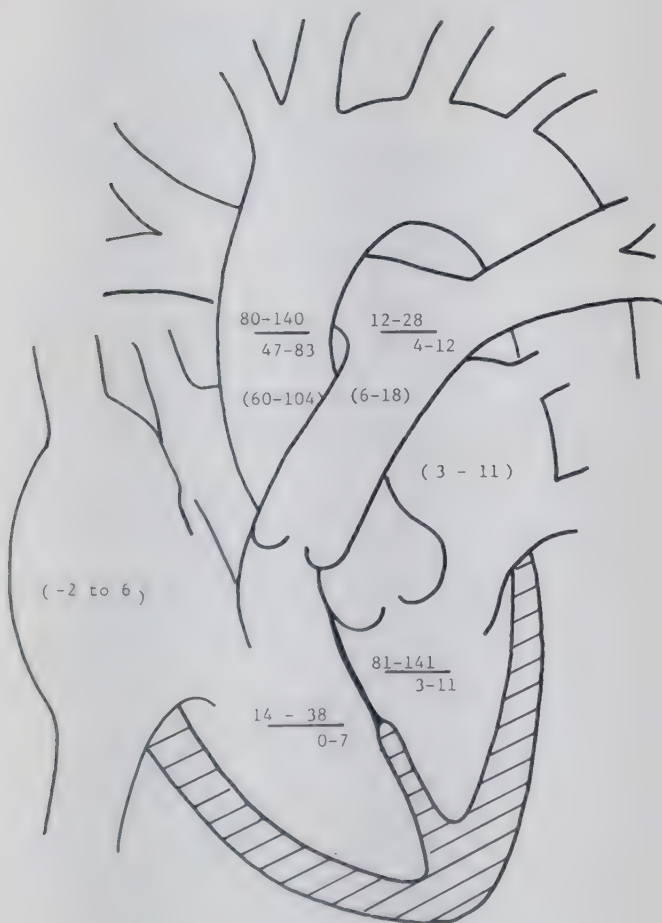


Antero-Posterior

Left Anterior Oblique

Right Anterior Oblique

NORMAL INTRACARDIAC PRESSURES



Normal pressures based on normal patients 2 months to 20 years of age

Systolic/Diastolic with ± 2 S.D. range
(Mean Pressure)

E N D O C R I N O L O G Y

1. Thyroid Tests

Normal values must be obtained from the individual laboratory as methods and means of reporting vary between labs.

a. PBI (Protein Bound Iodine)

Normal Values - 4- 8 micrograms%
 Birth - 7-10 micrograms%
 7 days - 7-12 micrograms%
 14-21 days - Returns to normal values

This test (no longer done routinely by Bioscience) measures all iodinated proteins in serum, in contrast to next test which measures only thyroxin and certain dyes.

b. Thyroxin (T4) by Column

(This is now the routine test done by Bioscience)

Normal Values = 2.9-6.2 micrograms%

c. Free Thyroxin

Measures metabolically active T4 in contrast to T4 by column which measures all available T4.

Normal Values = 1.0-2.1 micrograms%

d. Thyroxin Binding Globulin (TBG)

Measures the amount of protein present that can bind thyroxin. This goes up with estrogen; falls in protein losing nephropathy. Occasional congenital deficiency occurs.

Normal Values = 12-25 mgm

e. RAI (Radioactive I¹³¹ Uptake)

Measures uptake of I¹³¹ by thyroid gland.

2-5 microcuries of RAI in water are given orally and uptake is measured at 4 and 24 hours. The activity over thyroid is expressed as a percentage of activity of a standard solution of I¹³¹.

Normal Values = 4 hours: 5-15%
 24 hours: 15-45%

f. T3 Suppression

When T3 (Triiodothyronine) is given, TSH formation is suppressed unless the gland is functioning autonomously as in thyrotoxicosis.

Method: Do RAI as above. Then administer T3 in a dose of 125 mg/day for 7 days repeating the RAI on Days 6 and 7. Normally the value should fall to 40% of control RAI.

g. Thyroid Scan

h. Thyroid Antibodies

In certain conditions, such as Hashimoto's Thyroiditis, antibodies against components of the thyroid gland may be measured.

i. TSH by Immunoassay

This test is helpful if TSH is elevated but can not differentiate abnormally low values from normal as 40% of normals have values less than sensitivity of the assay.

Normal = 0-7 micro-units/ml

2. Toluidine Blue Stain for Chromatin Pattern of Buccal Smear

- a. Preparation of Smear from Buccal Mucous Membrane: The mucous membrane is wiped with saline soaked gauze to remove bacteria and debris which might interfere with the interpretation of the smear. A metal spatula with a rounded end but a sharp angled scraping edge is used to scrape the buccal mucous membrane with mild to moderate pressure such that a small but visible amount of whitish material is seen at the end of the spatula base. The scraping is "dabbed" onto the center of a slide (not albuminized), spread thinly and evenly, and immediately inserted into the fixative.
- b. Fixative: 95% ethyl alcohol. The slides may remain in the fixative for 1 to 2 hours.
- c. Staining

Toluidine blue	-	4 minutes
Distilled H ₂ O	-	2 dips
95% Ethanol	-	12 dips
100% Ethanol	-	12 dips
Xylene + mount		
- d. Reading of the Smear: Count 100 good quality cells under oil immersion. In the female, more than 20% of cells show a darkly stained chromatin mass adjacent to the nuclear membrane. Often a chromatin mass is seen within the nucleus which is not at the periphery. A cell is considered positive, however, only when a mass is noted against the nuclear membrane. In the male most cells show no mass at the nuclear membrane. Occasionally an

ill-defined mass is seen but the percentage should not exceed 2%.

In females with the trisomy XXX syndrome and in males with trisomy XXXY "double" chromatin masses are seen and one patient has been described with four separate peripheral nuclear chromatin bodies.

- e. Control: In order to be sure that the stain is proper, a female control buccal smear is run through with each group of unknowns. The easy visualization of the chromatin mass in the female control smear is a test of the adequacy of the staining technique.

3. Tests for Estrogen and Gonadotropins (LH + FSH)

a. Vaginal Smears

As children often have very little secretion, it is sometimes necessary to have a drop of salt solution in a pipette before attempting to aspirate the vagina. The aspirated secretion is immediately spread thinly upon a slide and immediately fixed for 1 minute in a mixture of ether and 95% alcohol in equal parts, allowing no drying lest distortion of the cells and their staining characteristics occur. The Shorr's stain is then applied by dropper, left on for about 1 minute, and the slide is dehydrated by dipping 3 times into 70% and then 95% alcohol. It is next blotted and cleared well in xylol. The slide is then mounted as a permanent preparation. The entire procedure requires 3 minutes. Reliance should be placed only on the picture observed in the thin areas of the slide.

b. Urinary Gonadotropin (Bioassay)

- 1) Significance: This is a biological test designed to measure urinary pituitary gonadotropin concentration.
- 2) Method of Assay: The protein hormone is precipitated and purified; then it is injected into immature female mice (white). Gross enlargement of the uterus occurs if test is positive.
- 3) Normal Values: Not normally found in urine before puberty. Males and females age 20-45 years excrete 6-52 mouse units per 24 hours. Sexually mature persons between 15 and 20 will also excrete this amount.
- 4) Abnormal Values: Test is not specific for pituitary gonadotropin, as pregnancy or chorionepithelioma give high titers. Serves to differentiate sexual infantilism or amenorrhea due to primary end-organ

deficiency from that due to pituitary deficiency. In the former condition FSH may be very high, whereas in the latter it is low.

- 5) Method of Collection: 24 hour urine specimen. To be stored cold during collection and frozen as soon as completed.

c. Radioimmunoassay

Serum LH and FSH may now be measured by radioimmunoassay techniques. Both tests are performed on 10 cc of clotted blood.

These tests are specific for pituitary gonadotropins and are considerably more sensitive than bioassay methods. Normal values are as follows:

FEMALES

Age	FSH in mIU/ml		LH in mIU/ml	
	Range	Mean	Range	Mean
2-4	3.1-4.5	3.7	2.0-4.0	2.8
5-8	3.4-5.8	4.5	2.5-4.0	2.6
9-10	3.4-7.7	5.4	2.2-12.0	4.0
11-12	5.0-12.0	7.5	2.4-14.0	8.7
13-16	3.5-13.3	8.0	3.8-22.0	9.6
17-18	4.4-13.0	8.6	5.0-29.0	15.3

ADULT FEMALES

Menstrual Cycle	FSH in mIU/ml		LH in mIU/ml	
	Range	Mean	Range	Mean
Follicular	4.0-17.2	8.3	5.0-57.0	12.8
Midcycle Peak	13.7-22.5	19.3	76.0-90.0	83.5
Luteal	4.0-15.0	6.9	3.0-41.0	11.6

MALES

Stage*	Age	FSH in mIU/ml		LH in mIU/ml	
		Range	Mean	Range	Mean
I	5-11	2.5-7.0	4.5	2.5-5.8	3.9
II	10-13	3.0-9.0	5.9	4.0-12.0	6.8
III	12-14	2.5-14.0	8.1	6.0-11.0	8.5
IV	12-17	3.5-15.0	8.5	4.0-15.5	9.5

*Staged according to Tanner, J.M., 1962, Growth at Adolescence, Blackwell and Mott, Ltd., Oxford, pg. 32.

4. Tests for Human Growth Hormone (HGH)

This hormone may now be measured by a radioimmunoassay technique. However, HGH is not usually found in the serum unless provocative stimuli are used. The two standard stimulation tests are: 1) the response to arginine and

- 2) the response to insulin induced hypoglycemia.

Absence of HGH on a screening test is not diagnostic alone and provocative tests must be performed. Both tests must be used before an individual is considered to have no growth hormone response.

a. Screening Tests

1. Sleep Specimen: A majority of normal subjects will have a significant release of HGH 45-60 minutes after sleep (this applies to night time sleep, not naps in infants). If a single specimen obtained at this time has greater than 5 $\mu\text{g}/\text{ml}$, HGH deficiency is ruled out.
2. Exercise Test: Greater than 90% of normals will release significant amounts of growth hormone following exercise which rules out hypopituitarism and obviates a more time-consuming tolerance test.

a. Procedure:

- 1) Patient must be fasting for at least 4 hours.
- 2) After lying still for 30 minutes the control sample is drawn.
- 3) The patient then exercises for 20 minutes consisting of rapid walking for 15 minutes followed by rapid walking up and down steps for 5 minutes. It is important that this exercise be strenuous. At the completion of this time, the second sample for growth hormone is drawn. After a 20 minute period of lying down the final sample is drawn.

- b. Interpretation: If any one of the three samples has greater than 5 $\mu\text{g}/\text{ml}$ of growth hormone, hypopituitarism can be excluded.

b. Arginine-Insulin Tolerance Test

1. Necessary Equipment:

- a. I.V. Volutrole set, 3 way stop cock, arginine solution, 500 cc Normal Saline, and #19 butterfly.
- b. 9 Heparinized tubes with suitable tops for use in centrifuge.
- c. 9 tubes with tops for storing plasma.

2. Procedure:

- a. Start I.V., draw initial sample as control.

- b. Arginine is infused over a 30 minute period at a dosage of 0.5 gm/kg/30 min.
 - c. Bloods drawn as follow:
 - 0 minutes - control
 - 15 minutes - Arginine infusing
 - 30 minutes - Arginine finished
(begin normal saline)
 - 45 minutes -
 - 60 minutes - Control insulin blood.
 - d. At 60 minutes of arginine test, inject insulin at dose of 0.075 unit/Kg = insulin 0 time.
 - e. Bloods drawn at 20, 30, 45, 60 minutes after insulin.
 - f. Patient must be observed during entire test for signs of hypoglycemia.
 - g. As each specimen is obtained it should be centrifuged and separated.
3. Significant Response: 5 mugs at any time during test.

5. Steroid Assay Methods

a. Resting Levels of Urinary 17-Hydroxycorticosteroids (17-OHCS)

1. Significance: The group of steroids measured by this test represents approximately 1/3 of the end products of the metabolism of cortisol (also called hydrocortisone, compound F, 17-Hydroxycorticosterone). Cortisol is the main corticosteroid produced by human adrenals.
2. Technique for Test: A 24 hour urine collection (refrigerate during collection). No preservative is necessary. The specimens must be sent to the laboratory immediately after collection. The 17-OHCS are destroyed when samples are kept at room temperature or in a refrigerator but will remain indefinitely if samples are kept frozen.
3. Normal Values:
 - Adult Males = 3-9 mg/24 hours
 - Adult Females = 2-8 mg/24 hours
 - 6 mos-15 yrs = 3.1 ± 1.0 mg/M²/24 hours
4. Abnormal Values:

The values may be decreased in:

- a) Inanition states; anorexia nervosa.
- b) Pituitary deficiency involving adrenocorticotrophic hormone.
- c) Addison's disease.
- d) Administration of synthetic, very potent corticosteroids such as prednisone (Deltasone, Meticorten, etc.), triamcinolone (Aristocort, Kenacort), dexamethasone (Decadron, Deronil, etc.)

- e) Congenital adrenal hyperplasia due to 21-hydroxylase deficiency (not always).
- f) Liver disease; hypothyroidism.
- g) Newborn period (due to decreased glucuronidation, but cortisol secretion is not decreased).

The values are increased in:

- a) Cushing's Syndrome.
- b) ACTH, cortisone, cortisol therapy.
- c) Medical and surgical stress (and to a slighter degree, emotional stress).
- d) Obesity (not always).
- e) Hyperthyroidism.
- f) Congenital adrenal hyperplasia due to 11-hydroxylase deficiency (due to compound S metabolites rather than cortisol metabolites).

b. Resting Levels of Urinary 17-Ketosteroids

- 1) Significance: This group of urinary steroids represents a part of the end products of adrenal and testicular androgen metabolism.
- 2) Method of Assay: The reaction of m. di-nitrobenzene in alkaline solution with the group -- CH_2O -- produces a characteristic color, which is measured colorimetrically.
- 3) Normal Values:

First few weeks	- up to 2 mg/24 hours
1 month-5 years	- 0.5 mg or less/24 hrs
6-9 years	- 1-2 mg/24 hours
Puberty	- Progressive increase to adult levels
Normal adult male	- 7-17 mg/24 hours
Normal adult female	- 5-15 mg/24 hours
- 4) Abnormal Values: In normal children to 8 years of age and in Addison's Disease, anorexia nervosa, and panhypopituitarism, little or no 17-ketosteroids are found in the urine. Removal of the testes causes a slight decrease. Increases in urinary 17-ketosteroid values may be caused by:
 - a) Adrenal hyperplasia.
 - b) Virilizing tumor of adrenal cortex.
 - c) Cushing's Syndrome (with or without tumor).
 - d) Interstitial cell tumor of testis (rare).
 - e) Administered hormones such as testosterone and testosterone propionate (not methyl testosterone), and by ACTH and cortisone.

- f) Alarming stimuli, such as burns, x-ray sickness, etc.

c. Resting Levels of Plasma Corticoids (or Cortisol)

- 1) Significance: This test measures cortisol, corticosterone, and compound S. Only the unbound steroids are usually measured. But it is also possible to measure those compounds which are conjugated with glucuronic acid.
- 2) Technique for Test: 2 ml of heparinized blood is required. The cortisol samples must be collected between 8-9 a.m. and sent to the laboratory immediately after collection as plasma must be separated as soon as possible. This is a protein-binding assay. One can separate, if necessary, cortisol from corticosterone and compound S by using an initial paper chromatographic step.
- 3) Normal Values: 8-12 micrograms/100 ml plasma. Because of the existence of a very marked diurnal variation of plasma 17-OHCS levels, it is important to collect the blood between 8-9 a.m.
- 4) Abnormal Value: Same as abnormal values for urinary 17-OHCS. However, plasma 17-OHCS are usually normal in anorexia nervosa, liver disease, hypothyroidism, hyperthyroidism and obesity. Elevated plasma values are found during pregnancy (due to increased concentration of cortisol binding globulin) and during estrogen therapy (particularly women on contraceptive medication). The comparison of 8 a.m. and 8 p.m. levels can be useful as screening test for Cushing's.

d. Adrenal Capacity (ACTH Tests)

The IM ACTH Test:

- 1) Significance: Measures the maximal capacity of the adrenal gland to produce cortisol.
- 2) Technique:

Days 1 and 2	:	24 hour urine collections for control 17-OHCS
Days 3, 4, 5, 6	:	Administer IM 40 mg ACTHAR Gel every 12 hours for 4 days (in children: 20 mg/

M² for each injection). Collect 24 hour urine specimens on Days 5 and 6 for urinary 17-OHCS.

- 3) Normal Values: Urinary 17-OHCS increase by 5 to 10 times the normal resting 17-OHCS values.
- 4) Abnormal Values:
 - a) A lack of response is pathognomonic of Addison's Disease.
 - b) A subnormal response is often found in congenital adrenal hyperplasia.
 - c) After cessation of long-term cortisone-like treatment, patients will usually have normal response.
 - d) A hyper-response is seen in some cases of Cushing's Syndrome (however, an IV ACTH is more appropriate--see below).

The I.V. ACTH Test:

- 1) Technique: 25 I.U. of ACTH or Synactin (for ACTH usually 1 I.U. = 1 mg; for Synactin 1 I.U. = 0.01 mg) are diluted in 300-500 ml of normal saline or normal glucose and the mixture is given I.V. over a period of 6 hours, starting at 8-9:00 a.m. Blood samples are taken just prior to the ACTH infusion and 2, 4, and 6 hours after the beginning of the infusion. If the infusion ends before the end of the 6 hour period, the last blood sample must then be taken at the completion of this infusion.
- 2) Normal Values:
At 6 hours = $40 \pm 6 \mu\text{g}/100 \text{ ml}$
- 3) Abnormal Values: The I.V. ACTH test is of particular interest in Cushing's Syndrome:
 - a) A total lack of response is characteristic of an adrenal carcinoma, but a normal response does not exclude a tumor.
 - b) A hyper-response is characteristic of bilateral adrenal hyperplasia, but a normal response does not exclude hyperplasia.

In patients whose adrenals have been suppressed for more than one month, the I.V. test is usually not prolonged enough to produce adrenal reactivation.

e. Tests of ACTH Capacity of Pituitary Gland (SU-4885 Test)

1. Significance: SU-4885 has the property to inhibit 11-hydroxylase enzyme in

the adrenal cortex. This blocks the normal formation of cortisol with decreased blood cortisol levels. If a normally functioning pituitary gland is present, a compensatory increased secretion of ACTH will result in an almost normal secretion of cortisol but also in a large secretion of 11-deoxy-precursors of cortisol (compound S). The latter is excreted, like cortisol, as 17-OHCS.

2) Technique:

Days 1 and 2 : No medication
 Day 3 : Administer orally 500 mg of SU-4885 (Methopirapone Ciba) every 4 hours for 24 hours (in children: approximately 300 mg/M² every 4 hours for 24 hours)
 Day 4 : No medication. Collect 24 hour urine collection during the 4 experimental days for urinary 17-OHCS

3) Normal Results: Urinary 17-OHCS on either Day 3 or Day 4 increased by 2.5 to 6 times the normal control 17-OHCS values, and should reach a level of 9 mg/M²/24 hours.

4) Abnormal Values: No or little response in patients with pituitary ACTH deficiency, in certain patients with hypothalamic tumors, and in subjects who have just stopped corticoid therapy (pharmacological dosages). Of course, no response will be obtained in patients with primary adrenal insufficiency.

f. Pituitary Suppression Tests

1) Significance: The administration of dexamethasone, a potent synthetic corticoid, will suppress ACTH secretion in the normal subject resulting in decreased endogenous secretion of cortisol. Since dexamethasone is not excreted as a 17-OHCS, the values of urinary 17-OHCS will decrease.

2) Technique:

Days 1 and 2 : No medication
 Days 3, 4, and 5 : Administer dexamethasone, 1.25 mg/100 lbs of body weight/day (in 4 divided doses, every 6 hours)

Days 6, 7, and 8 : Administer dexamethasone, 3.75 mg/100 lbs of body weight/day (in 4 divided doses, every 6 hours)

Collect 24 hour urine collection on experimental Days 1, 2, 4, 5, 7, 8 for urinary 17-OHCS.

3) Normal Results: By Day 5, the urinary 17-OHCS have decreased to < 2 mg/24 hours.

4) Abnormal Values:

- a) In Cushing's Syndrome from any cause: By Day 5, urinary 17-OHCS are > 2 mg/24 hours.
- b) In Cushing's Syndrome due to bilateral adrenal hyperplasia: By Day 8, urinary 17-OHCS are < 2 mg/24 hours, except if the hyperplasia is due to an ACTH producing tumor located outside of the pituitary gland (mediastinal, lung, etc.).
- c) In Cushing's Syndrome due to adrenocortical carcinoma: By Day 8, urinary 17-OHCS are > 2 mg/24 hours. In certain cases of hypothalamic tumor, no suppression is obtained.

6. Salt Deprivation Test

Patient is kept on constant low salt diet (9 mEq/day) for 5 days. Urine and serum electrolytes are measured.

In normal person after 5 days the serum electrolytes will be normal and less than 9 mEq/day of sodium will be excreted.

This test is often carried out along with determination of aldosterone secretion rate. On Day 5, aldosterone secretion rate should increase 2 to 5 times from the control values of 80 ± 30 (S.D.) picogram/24 hour.

7. Water Load Test

a. Method:

- 1) N.P.O. after 6 p.m.
- 2) At 10:30 p.m. void and discard urine.
- 3) Collect and measure subsequent urine to 7:30 a.m.
- 4) At 7:30 a.m. administer 20 ml water/kg PO over 30 minutes.
- 5) Collect and measure urine at 9 a.m., 10 a.m., 11 a.m., and 12 noon.

b. Interpretation:

- 1) Normal individual excretes 70% of water load.
- 2) Normal person excretes greatest volume during second hour (10 a.m. sample).

- 3) In the normal, one of the hourly volumes will exceed the night volume.
- c. Significance:
Patients with adrenal cortical insufficiency or hypopituitarism are unable to excrete large volumes of dilute urine in response to a water load.

NOTE: This test is not valuable in presence of diabetes insipidus, renal disease and probably liver disease.

Water load test can be repeated with small amounts of ACTH to determine whether patient is hypopituitary, or has primary hypoadrenalism.

8. Pitressin Test

a. Method:

- 1) Measure intake and output as well as specific gravity with ad lib fluids for 24 hours.
- 2) Have patient empty bladder and give 0.3 ml/M² IM of aqueous pitressin.
- 3) Follow urine specific gravities and patient's thirst carefully. The effect should occur in 4-6 hours; the critical period being approximately the 6th hour.
- 4) If no effect after 6 hours, repeat with 0.6 ml/M² IM of aqueous pitressin and follow as before.

b. Interpretation:

- 1) If intake decreases and specific gravity increases, ADH deficiency probably present. It is then necessary to repeat test with a placebo control (most interested in thirst).
- 2) If intake stays the same and specific gravity increases, psychogenic diabetes insipidus probable.
- 3) If intake stays same and specific gravity does not increase, ADH resistant diabetes insipidus or chronic renal disease probable.

9. Hypertonic Salt Test (Hickey-Hare, Carter-Robbins)

- a. Procedure: Fluids withheld for 8 hours preceding test. Then 20 cc water per kg given by mouth over period of 1 hour. Thirty minutes after period of hydration is begun, an indwelling catheter is inserted. Urine specimens are collected in 15 minute periods and urine flow calculated in ml/minute. After two control periods with adequate urine flow, a solution of 2.5% NaCl is given IV at rate of 0.25 ml/kg/minute for 45 minutes. If no response (oliguria) in 1/2 hour or more, test with 0.1 unit of pitressin IV.

- b. Interpretation: In normal individuals or those with psychogenic polyuria (occasional exceptions) there is a marked reduction of urine flow beginning after 15 minutes. In cases of diabetes insipidus, there is no response, and the pitressin should be tried as above.

Ref: J. Clin. Endocrinol. 7:753, 1947.

10. Tests for Pheochromocytoma

a. Regitine (Phentolamine) Test

Regitine is an adrenolytic drug used as a diagnostic agent in the detection of epinephrine-producing tumors of the adrenal or extra-adrenal chromaffin tissue.

- 1) Method: Do not give a sedative in the period before the test.
- 2) Dose: 5-10 milligrams in the adult and 1-5 in the child. It may be given IM or IV, but the IV route is preferred.

The patient should be in the supine position. An IV drip should be started with normal saline and allowed to drip slowly for 20-30 minutes in order to allow the blood pressure to stabilize. A blood pressure cuff should be attached to the other arm. Three blood pressure readings should be obtained after the pressure is stabilized, and the last two readings at 1 minute and 1/2 minute before injection of the drug. The drug should be injected over a 2 minute period slowly. Blood pressure and pulse readings should be taken at 1 minute intervals for 10-15 minutes after injection. A significant blood pressure drop will last 10 minutes or longer. False positive tests may occur.

- 3) Side Effects: Any symptoms occur within 1 or 2 minutes and rarely last 3 minutes. Look for tachycardia, nervousness, cold and clammy extremities, hyperpnea, mild headache, and precordial distress.

b. Benzodioxane Test (Benodaine)

This drug acts in the same way as Regitine but has more side effects.

Dose: 0.25 milligrams per kg in adults to a maximum of 20 milligrams. In children the dose must be calculated from a basal metabolism nomogram and is 10 milligrams/M².

c. Catechol Amines in the Urine

This is a more specific test for epinephrine and norepinephrine secreting tumors. It should be relied on whenever time permits its usage. A 24 hour sample of urine is sent to the chemistry laboratory. Sample should have 8 ml of concentrated HCl added during collection. If possible urine should be obtained during a paroxysm of hypertension.

Normal: Less than 100 micrograms/24 hours.

d. Vanillyl Mandelic Acid (VMA)

3-Methoxy-4-Hydroxy Mandelic Acid: This metabolite of adrenalin and noradrenalin may be found elevated in cases of pheochromocytoma or neuroblastoma which do not show an elevated catecholamine urine level.

There is a paper chromatographic and a colorimeter method of determination.

No fruits, tea, coffee, or vanilla-containing foods for at least 24 hours.

Collect 24 hour urine, acidified with 15 cc of concentrated HCl.

Normal: 3-9 $\mu\text{g}/\text{mg}$ creatinine.

Ref: Arch. Dis. Child. 39:168, 1964.

e. Homovanillic Acid (HVA)

This metabolite is a common end product of DOPA and DOPAMINE, precursors of the catechol amines. HVA excretion is independent of dietary factors. Patients with neuroblastoma show a marked increase in HVA excretion, while those with pheochromocytoma excrete normal amounts of HVA.

The DOPA and DOPAMINE assay may be substituted for this determination of HVA.

As with VMA, a 24 hour urine is collected in a dark bottle, with 5-10 ml of 6 N HCl added.

Normal: 50 $\mu\text{g}/\text{mg}$ creatinine.

Ref: Arch. Dis. Child. 39:168, 1964.

11. Tests of Parathyroid Function

a. Serum Calcium and Phosphate Levels

A prolonged test may be used for more accurate studies. Parathyroid hormone extract (50-250 units) is administered IM every 6 hours for 4-5 days, with daily serum calcium and inorganic phosphate determinations. There is a progressive, sometimes rapid, rise in serum calcium and decrease in serum phosphate in hypoparathyroidism, while the high phosphate level persists in patients with pseudohypoparathyroidism.

Ref: Diagnosis and Therapy of Endocrine Disorders in Childhood and Adolescence, Wilkins. 2nd Ed., 1957.

b. Renal Phosphate Clearance

In addition to determining phosphate diuresis by the Ellsworth-Howard test, the serum inorganic phosphorous may be determined at zero time, and at 2, 4, and 6 hours. Phosphate clearances are then calculated by dividing the phosphorous content of each hourly urine collection by the serum phosphorous concentration covering the period of collection. In normal subjects the clearances increase twofold when expressed as $\text{cc/M}^2/24$ hours. A more drastic rise is observed in hypoparathyroidism.

c. Ellsworth-Howard Test

After an overnight fast, the patient should drink, at zero time, 100-200 ml water and thereafter 100 ml hourly, the last time at 5 hours for a total of 600-700 ml. The amount of fluid can also be calculated as 500 ml/M^2 at zero time, and 200 ml/M^2 at each subsequent hour.

Urine samples are collected at zero time and hourly thereafter, the last collection being made at 6 hours. It is also permissible to make urine collections for two 2 hour periods only, preceding and following the hormone injection, respectively.

Parathyroid extract (Lilly, Para-Thormone, 5 cc ampules, 100 units/cm^3) is injected IV 2 hours after zero time. The usual dose for adults, 200 units, is also the preferable dose for children of school age or older.

Untoward reactions to the hormone are rare, but they should be carefully watched for. Infants and younger children show good responses only with relatively higher doses, namely 50-100 units. The suggested calculation of 50 units/M² is not recommended for the younger age group; inadequate dosage has been the cause of false negative responses.

To insure the potency of the hormone preparation, a control test should be performed on a normal of the same approximate age. The collected urine specimens are analyzed for phosphate.

Results: A normal response is indicated by an increase in P excretion or clearance (during the 2 hour post-injection period) by about 50-100% over the pre-injection output. Patients with marked hypoparathyroidism but intact renal function show the same or an even greater responsiveness.

Absence of any increase in phosphate excretion is characteristically found in pseudohypoparathyroidism. Patients with renal insufficiency may also prove to be resistant. However, hormone resistance in normal subjects, and a positive response in pseudohypoparathyroidism have been known to occur. Vitamin D deficient infants do not respond to administration of the hormone. Nevertheless, the test has some clinical usefulness in the absence of more dependable methods.

Ref: Bull. Johns Hopkins Hosp. 55:296, 1934.

12. Bone Age:

- a. Wrist and Hand: To be read by the method by Greulich and Pyle.

Ref: Radiographic Atlas of Skeletal Development of the Hand and Wrist, Greulich and Pyle, 2nd Ed.

- b. Knee: To be read by the method of Pyle and Hoerr.

Ref: Radiographic Atlas of Skeletal Development of the Knee, Pyle and Hoerr.

- c. By special request hemiskeleton views may be taken to be read by the method of Wilkins.

Ref: Diagnosis and Treatment of Endocrine Disorders in Childhood and Adolescence, Wilkins, 3rd Ed., 1965.

DIAGNOSTIC METHODS FOR HORMONAL DISORDERS

HORMONE	CLINICAL TESTS	ASSAYS	CHEMICAL DETERMINATION URINE	CHEMICAL DETERMINATION BLOOD
PITUITARY HORMONES				
HGH	Arginine tolerance Insulin tolerance	Immunoassay on serum		
TSH	Response of I131 uptake to TSH			
ACTH	Dexamethasone suppression of 17-OHCS Metapirone (SU-4885) effect on 17-OHCS	Bioassay		
FSH		Immunoassay on serum		
LH		Immunoassay		
HCG		Pregnancy tests		
		Immunoassay		
Total Gonadotropins		Bioassay using uterine weight in mature mouse		
THYROID HORMONES	Serum cholesterol I131 uptake T3 suppression test			T4 by column PBI, free thyroxin, TBG
ADRENAL MEDULLARY HORMONES				
Epinephrine and/or Norepinephrine	Histamine test Regitine test	Bioassay for epinephrine	Epinephrine and nor- epinephrine VMA	Epinephrine and nor- epinephrine

ADRENOCORTICAL HORMONES				
Aldosterone	Serum Na, K, CO ₂ , Cl Sweat and saliva Na/K Response to Na deprivation Response to aldactone Aldosterone secretory rate	Na retention in adrenalectomized rats	Aldosterone	Aldosterone
Cortisol	"Water load test" Effect of ACTH on 17-OHCS Effect of dexamethasone on 17-OHCS Effect of SU-4885 on 17-OHCS Cortisol secretory rate	Bioassay	17-OHCS 17-Keto- genic	17-OHCS Cortisol
ADRENAL ANDROGENS	Suppression by dexamethasone of 17-KS	Bioassay	17-KS 11-oxy-17KS	17-KS
TESTICULAR HORMONES	Lack of suppression of 17-KS by dexamethasone	Bioassay	17-KS Testosterone	17-KS
OVARIAN HORMONES				
Estrogens	Vaginal smear or biopsy Endometrial biopsy		Estrogen	Estrogen
Progesterone	Basal temperature curve Endometrial biopsy Vaginal smear	Bioassay	Pregnane- diol	

PSYCHOLOGICAL TESTING

The following screening tests are aimed at providing the pediatrician with appropriate tools with which to determine whether or not a child should be referred for more exhaustive examination regarding the possibility of mental retardation.

Brief screening tools always bring with them a certain amount of error. The child with normal learning capacity may not be able to respond very well to a specific tool because it happens to touch an ability area that he is not particularly strong in. Hence, a child may be falsely identified as retarded. We may also have a child who can draw a human figure quite well but at the same time he may have a serious language handicap producing a specific learning disability. To use the brief screening tool to claim that there are no cognitive deficits to be concerned about is an example of improper use of a psychological tool.

The pediatrician therefore has to make a reasonable decision based on his impression of the child and on the presenting complaint. For example, a complaint that the child is doing very poorly in school automatically requires the intervention of a professional psychologist. The child may look normal on a screening test but may still be an example of a specific learning disability. He may appear retarded on your screening tests but, again, may be of normal intellectual ability while demonstrating a specific handicap.

The following tests are included because of their ease of administration and demonstrated reliability.

GOODENOUGH-HARRIS DRAW-A-PERSON TEST

1. Procedure: The child is supplied with a pencil (preferably a No. 2 with eraser) and a sheet of blank paper and instructed to "Draw a person", "Draw the best person you can". No additional directions are necessary. Encouragement may be supplied if necessary. Under no condition should the examiner suggest that the child's production needs to be supplemented or changed in any way; the only exception being the drawing of the stick figure. In this case the examiner is permitted to encourage the child to "draw a whole person."
2. Scoring: The child receives one point for each detail present according to the following scoring guides:

Drawing of a Man

- | | |
|---|---|
| 1. Head present | 19. Opposition of thumb shown (must include fingers) |
| 2. Neck present | 20. Hands present |
| 3. Neck, two dimensions | 21. Arms present |
| 4. Eyes present | 22. Arms at side or engaged in activity |
| 5. Eye detail: brow or lashes | 23. Feet: any indication |
| 6. Eye detail: pupil | 24. Attachment of arms and legs I (to trunk anywhere) |
| 7. Nose present | 25. Attachment of arms and legs II (at correct point of trunk) |
| 8. Nose, two dimensions (not round ball) | 26. Trunk present |
| 9. Mouth present | 27. Trunk in proportion, two dimensions (length greater than breadth) |
| 10. Lips, two dimensions | 28. Clothing I (anything) |
| 11. Both nose and lips in two dimensions | 29. Clothing II (2 articles of clothing) |
| 12. Both chin and forehead shown | |
| 13. Bridge of nose (straight to eyes; narrower than base) | |
| 14. Hair I (any scribble) | |
| 15. Hair II (more detail) | |
| 16. Ears present | |
| 17. Fingers present | |
| 18. Correct number of fingers shown | |

Drawing of a Woman

- | | |
|--|---|
| 1. Head present | 21. Opposition of thumb shown (must include fingers) |
| 2. Neck present | 22. Hands present |
| 3. Neck, two dimensions | 23. Legs present |
| 4. Eyes present | 24. Feet (any indication) |
| 5. Eye detail: brow or lashes | 25. Shoe "feminine" (any attempt such as high heels, open toe, strap) |
| 6. Eye detail: pupil | 26. Attachment of arms and legs I (to trunk anywhere) |
| 7. Nose present (not round ball) | 27. Attachment of arms and legs II (to trunk at correct point) |
| 8. Nose, two dimensions | 28. Clothing indicated (any) |
| 9. Bridge of nose (straight to eyes, narrower than base) | 29. Sleeve |
| 10. Nostrils shown | 30. Neckline (any indication) |
| 11. Mouth present | 31. Trunk present |
| 12. Lips, two dimensions | 32. Trunk in proportion, two dimensions (length greater than breadth) |
| 13. Both nose and lips in two dimensions | |
| 14. Both chin and forehead shown | |
| 15. Hair I (any scribble) | |
| 16. Hair II (more detail) | |
| 17. Necklace or earrings | |
| 18. Arms present | |
| 19. Fingers present | |
| 20. Correct number of fingers shown | |

3. Norms: minimum score for child to be within one standard deviation of age - appropriate mean.

Age	Drawing of Man		Drawing of Woman	
	by boys	by girls	by boys	by girls
3	4	5	4	6
4	7	7	7	8
5	11	12	11	14
6	13	14	13	16
7	16	17	16	19
8	18	20	20	23

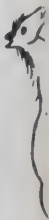
1. Try to get child to smile by smiling, talking or waving to him. Do not touch him.
2. When child is playing with toy, pull it away from him. Pass if he resists.
3. Child does not have to be able to tie shoes or button in the back.
4. Move yarn slowly in an arc from one side to the other, about 6" above child's face. Pass if eyes follow 90° to midline. (Past midline; 180°)
5. Pass if child grasps rattle when it is touched to the backs or tips of fingers.
6. Pass if child continues to look where yarn disappeared or tries to see where it went. Yarn should be dropped quickly from sight from tester's hand without arm movement.
7. Pass if child picks up raisin with any part of thumb and a finger.
8. Pass if child picks up raisin with the ends of thumb and index finger using an over hand approach.

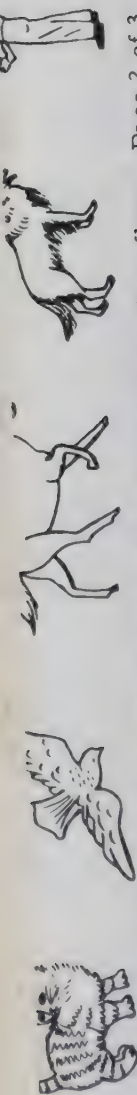


- | | | |
|--|---|---|
| <ol style="list-style-type: none"> 9. Pass any en-closed form.
Fail continuous round motions. | <ol style="list-style-type: none"> 10. Which line is longer?
(Not bigger.) Turn paper upside down and repeat. ($3/3$ or $5/6$) | <ol style="list-style-type: none"> 11. Pass any crossing lines. 12. Have child copy first. If failed, demonstrate |
|--|---|---|

When giving items 9, 11 and 12, do not name the forms. Do not demonstrate 9 and 11.

13. When scoring, each pair (2 arms, 2 legs, etc.) counts as one part.
14. Point to picture and have child name it. (No credit is given for sounds only.)





15. Tell child to: Give block to Mommie; put block on table; put block on floor. Pass 2 of 3.
(Do not help child by pointing, moving head or eyes.)
16. Ask child: What do you do when you are cold? ..hungry? ..tired? Pass 2 of 3.
17. Tell child to: Put block on table; under table; in front of chair, behind chair.
Pass 3 of 4. (Do not help child by pointing, moving head or eyes.)
18. Ask child: If fire is hot, ice is ?; Mother is a woman, Dad is a ?; a horse is big, a mouse is ? . Pass 2 of 3.
19. Ask child: What is a ball? ..lake? ..desk? ..house? ..banana? ..curtain? ..ceiling? ..hedge? ..pavement? Pass if defined in terms of use, shape, what it is made of or general category (such as banana is fruit, not just yellow). Pass 6 of 9.
20. Ask child: What is a spoon made of? ..a shoe made of? ..a door made of? (No other objects may be substituted.) Pass 3 of 3.
21. When placed on stomach, child lifts chest off table with support of forearms and/or hands.
22. When child is on back, grasp his hands and pull him to sitting. Pass if head does not hang back.
23. Child may use wall or rail only, not person. May not crawl.
24. Child must throw ball overhand 3 feet to within arm's reach of tester.
25. Child must perform standing broad jump over width of test sheet. (8-1 1/2 inches)
heel within 1 inch of toe.
26. Tell child to walk forward,  Child must walk 4 consecutive steps, 2 out of 3 trials.
Tester may demonstrate. Child must stand 3 feet away from tester. Child must catch ball with
27. Bounce ball to child who should stand 3 feet away from tester.
hands, not arms, 2 out of 3 trials.
28. Tell child to walk backward,  toe within 1 inch of heel.
Tester may demonstrate. Child must walk 4 consecutive steps, 2 out of 3 trials.

DATE AND BEHAVIORAL OBSERVATIONS (how child feels at time of test, relation to tester, attention span, verbal behavior, self-confidence, etc.):

PREPARATIONS FOR X-RAY EXAMINATIONS

1. Psychological Preparation

The child should be prepared for the examination, either by hospital personnel or his parents. If the child is an outpatient, the parents should be told enough about the examination so that they understand what the child will experience.

2. Bisacodyl (Dulcolax)

Tablets should not be taken within 1 hour of antacids or milk. They must not be chewed or crushed, but rather swallowed whole. Use suppositories unless you are certain the child can swallow the tablets whole. Dose: Below 40 kg: 1 tablet h.s.; above 40 kg: 2 tablets h.s.

Suppositories may be used at any age. If the first suppository does not produce a good bowel movement within 45 minutes, administer a second suppository.

Contraindications: Acute surgical abdomen, acute ulcerative colitis.

3. Upper Gastrointestinal Series

(A small bowel examination is part of each upper gastrointestinal series, except when there is severe gastric or duodenal obstruction.)

a. Patients less than 2 years old:

1. Nothing by mouth for 3 hours before the examination and until completed.
2. Bisacodyl suppository: one 90 minutes before the examination, and repeat in 45 minutes if the patient does not have a large bowel movement.

b. Patients 2 years or older:

1. Bisacodyl pill(s) or suppository h.s. (see 2).
2. Nothing by mouth for 4 to 6 hours (depending on size) before the examination and until completed.
3. Bisacodyl suppository: one 90 minutes before the examination, and repeat in 45 minutes if the patient does not have a large bowel movement.

4. Air Contrast Barium Enema

a. Patients less than 3 years old:

Arrangements must be made with the pediatric radiologist for this special examination and the correct preparation.

b. Patients 3 years of age and older:

1. Clear liquid diet for 48 hours before examination. No milk or dairy products.
2. 36 hours before examination: bisacodyl pill(s) or suppository (see 2).
3. 24 hours before examination: bisacodyl suppository (see 2).
4. 12 hours before the examination: saline enemas until clear.
5. N.P.O. for 3 hours before the examination.

5. Regular Barium Enema

(Omit steps b and d when evaluation is for possible Hirschsprung's disease, ulcerative colitis, or acute surgical abdomen.)

- a. Clear liquid diet for 24 hours before the examination. No milk or dairy products, except that infants may have regular formula.
- b. Bisacodyl pill(s) or suppository h.s. (see 2).
- c. N.P.O. for 4 hours (infants, 3 hours) before the examination and until completed.
- d. Bisacodyl suppository: one 90 minutes before the examination, and repeat in 45 minutes if the patient does not have a large bowel movement.

6. Excretory Urogram

- a. The patient should be normally hydrated but have an empty stomach. With the doses of contrast material recommended, dehydration prior to the procedure is contraindicated at all ages, and especially dangerous in infants or if there is uremia.
- b. An infant's feedings should be arranged so that the examination is started at the time of the next feeding; the feeding may be given as soon as the injection has been completed. Children should be N.P.O. for 4 to 6 hours (depending on size) before the examination.
- c. A carbonated beverage is frequently given during the examination. Be certain to indicate on the requisition if this sugar containing beverage is contraindicated.
- d. Bisacodyl suppository: one 90 minutes before the examination, and repeat in 45 minutes if patient does not have a large bowel movement.
- e. Have patient void just before examination.
- f. Dose: Renografin-60

0 - 2.5 kg	By consultation with the pediatric radiology staff
2.5 - 5 kg	4 ml/kg
5 - 10 kg	20 ml
11 - 25 kg	2 ml/kg
above 26 kg	50 ml

7. Cystourethrogram

- a. N.P.O. for 3 hours before the examination.
- b. Bisacodyl suppository: one 90 minutes before the examination, and repeat in 45 minutes if patient does not have a large bowel movement.

8. Herniogram (Positive Contrast Peritoneal Study)

- a. Requires consent sheet to be signed by parent or guardian.
- b. N.P.O. for 3 hours before the examination.
- c. Bisacodyl suppository: one 90 minutes before the examination, and repeat in 45 minutes if patient does not have a large bowel movement.
- d. Contraindications:
 - 1. Hypersensitivity to contrast material.
 - 2. Urinary retention.
 - 3. Peritonitis.
 - 4. Distended bowel (mechanical obstruction, paralytic ileus, gastroenteritis, etc.).
 - 5. Ventriculo-peritoneal shunt for hydrocephalus.
 - 6. Bleeding tendency.
 - 7. Abdominal wall infection.

9. Pelvic Pneumography

- a. Requires consent sheet to be signed by parent or guardian.
- b. Same preparation as for regular barium enema.

10. Cholecystogram

- a. The diet should contain fat the day before the examination. On the evening of the examination, however, give a light meal that avoids all fat, including eggs, milk and other dairy products.
- b. Iopanoic acid (telepaque) 0.5 gm (one tablet) for each 10 kg of body weight, not to exceed 3.0 gm (6 tablets). Starting after dinner, give 1 tablet each 15 minutes with water. The tablets may be crushed and administered in food.
- c. N.P.O., except ordinary amounts of water, following the iopanoic acid until the examination. Infants should have clear fluids or, if important, their usual formula.
- d. Should diarrhea follow administration of iopanoic acid, treat promptly.
- e. A chocolate fatty meal is usually given as part of the examination. Inform the department if there is hypersensitivity to chocolate or other contraindication.
- f. If necessary, the examination may be repeated once, the next day. Use the same dose of iopanoic acid; do not give a "double dose."

DERMATOGLYPHIC PATTERNS ASSOCIATED WITH CONGENITAL ANOMALIES

AREA	NORMAL	RARE	CONDITION
4th and 5th fingers	Ulnar Loop or Whorl	Radial Loop	Mongolism; Rubella Syndrome
Same Pattern on 7 or More Digits	Rare	Arches; Ulnar Loops	Trisomy 18; Mongolism
Axial Triradius	Proximal	Distal	Mongolism; D1 Trisomy; Congenital Heart Disease; Rubella Syndrome; Turner's Syndrome
Hypothenar	Patternless	Loop or Whorl	Mongolism; Turner's Syndrome; XXYY Klinefelter's
Thenar and First Interdigital	Patternless	Whorl or Loop	Cir-du-chat Syndrome
Bilateral Simian Crease	Absent	Present	Mongolism; D1 Trisomy; Trisomy 18; Rubella Syndrome
Clinodactyly	Absent	Present	Mongolism
Hallucal Area	Loop or Whorl	Arch Tibial	Mongolism

S K I N T E S T S

1. Cat Scratch Disease Skin Test

Antigen prepared from involved lymph nodes of infected human. Dose: 0.1 ml of antigen ID. Interpretation: Read at 24 hours. Positive area of erythema and induration 2-4 cm in diameter with central 6-8 mm papule.

2. Chancroid Skin Test

Saline suspension of killed *Hemophilus ducreyi* organisms. Dose: 0.05 ml ID. Interpretation: Read at 48 hours. Positive reaction consists of induration over 2 cm in diameter, remains positive after recovery and therefore does not distinguish past from present infection.

3. Coccidioidin Skin Test

1:100 dilution of filtrate of a selected strain of *Coccidioides immitis*. Dose: Dilute 1:100 to 1:1000 and inject 0.1 ml of latter ID. Read at 48 hours. If negative, repeat with 1:100. Interpretation: Read at 48 hours. Induration over 1.5 cm in diameter is positive. Positive reactions usually obtained 2-4 weeks post infection, remain positive for years.

4. Echinococcus Skin Test

Antigen obtained from dog tapeworm or from hydatid fluid. Dose: 0.25 ml ID with nearby control saline injection. Interpretation: Read at 1/2 hour and 24 hours. Initial blanching of test area usually increases and may show pseudopods. Positive 1/2 hour reaction has wheal at least 2.4 cm in one diameter, or 2.2 cm in both diameters. Positive 24 hour reaction has infiltration and edema at least 4 cm in diameter. Indicates present or past infection, remains positive for life.

5. Histoplasmin Skin Tests

Culture filtrate of *Hist. capsulatum*. Dose: 0.1 ml of 1:100 dilution ID. Interpretation: Read at 48 and 72 hours. Positive if at either reading induration is more than 0.5 cm in diameter. Cross reaction may occur with other fungi (*B. dermatitidis*, *C. immitis*, or *C. albicans*). Repeated testing may stimulate complement fixing antibody.

6. Lymphogranuloma Venereum Skin Test (Frei Test)

Antigen prepared from chick-embryo grown virus. Dose: 0.1 ml ID and control. Interpretation: Read at 48 and 72 hours. Positive is reddish

papule 6 mm or more in diameter surrounded by faint erythematous area. Use control to rule out sensitivity to chick protein. Reaction remains positive after infection for many years. Cross reaction may occur with psittacosis group of viruses.

7. Moloney Test for Diphtheria Toxoid Sensitivity (Modified)

1:100 dilution of fluid toxoid to determine degree of sensitivity to diphtheria toxoid prior to its use in active immunization of children over 10 years and adults. Dose: 0.1 ml ID. Interpretation: Read at 48 hours. Reaction positive if erythema more than 1.0 cm in diameter. Positive test calls for most cautious use of diphtheria toxoid.

8. Mumps Skin Test

Killed virus suspension prepared from extra-embryonic fluid of infected chick embryos to determine susceptibility to mumps during or after adolescence. Dose: 0.1 ml ID. Interpretation: Read at 24 and 36 hours. Immunity, although not a reliable indicator, is indicated by induration and erythema 1.5 cm or more in diameter. The mumps skin test may also be helpful in supporting the diagnosis of endocardial fibroelastosis.

Ref: J. Pediat. 62:604, 1963.

9. Sarcoid Skin Test (Kveim)

Ground sarcoid lymph nodes tested for sterility and preserved with phenol. Dose: 0.1-0.2 ml ID. Interpretation: Red-purple papule appears in 7-14 days, grows slowly for 4-6 weeks. When papule maximal in size (3-8 mm) biopsy of papule in positive test shows epithelioid and giant cells surrounded by inflammatory cells. Reports vary concerning efficiency (64-94%) in diagnosis.

10. Shick Test

Sterile solution of toxic growth products of *C. diphtheriae*. Dose: 0.1 ml (1/50 M.L.D. of toxin) ID. Interpretation: Read in 3-4 days. Positive reaction (non-immune) consists of circumscribed redness and infiltration 1-2 cm in diameter.

11. Toxoplasma Skin Test

Extract of killed organisms. Dose: 0.1 ml (1:500) ID. Interpretation: Read at 24 and 48 hours. Positive result induration 0.5 cm in

diameter. False positive results may occur.

12. Trichinella Skin Test

Extract of dried, ground trichinellae. Dose: 0.10-0.02 ml ID with saline control. Interpretation: Observe for 24 hours. Positive reaction is of immediate type, usually within 15-20 minutes after injection, rarely delayed to 24 hours, and consists of induration of 1-3 cm or of erythema of 1-5 cm. Control rarely shows induration more than 0.3 cm and erythema more than 0.5 cm. Tests usually not positive until second week of infection. Normals may have positive reactions from previous unrecognized trichinosis or crossreacting parasites, such as trichuris trichiura.

13. Tuberculin Tests

International Units	Old Tuberculin Dose	Dilution	PPD Strength
1	0.01 mg	1:10,000	First
5	0.05	1:2,000	Intermed. = Tine
10	0.10	1:1,000	= Patch (Vollmer)
100	1.00	1:100	Second

Methods:

- Intradermal:** Inject 0.1 ml of test material. Record mm of induration after 2-3 days. Interpretation: < 5 mm induration is negative; 5 mm to 9 mm is consistent with M. Tuberculosis, atypical mycobacteria, or previous BCG; 10 mm or greater is almost always only M. tuberculosis.
- Tine:** Press disc firmly into the skin of the alcohol washed and dried forearm, using enough pressure to leave 4 visible puncture sites. Measure induration after 2-3 days. Interpretation: 2 mm induration around any one point is equivalent to 5 mm induration with 0.05 mg OT. Positive reactions tend to coalesce.
- Patch Test:** Not used because of high incidence of false negative reactions.

NOTES:

- Subcutaneous injection or not injecting exactly 0.1 ml makes quantitation invalid.
- 5 Tuberculin Units used for routine screening: 1 TU may give false negatives, and 100-250 TU may give false positives and severe reactions.

M I S C E L L A N E O U S

1. Sweat Electrolyte Test Using Pilocarpine Iontophoresis

- a. Purpose: Localized sweating induced by applying iontophoresis of pilocarpine to small skin area, and sweat collected onto filter paper.
- b. Method: Each of the EKG electrodes is plugged to the positive or negative pole of the power supply. Two squares of filter paper are cut (with dimensions somewhat larger than the electrodes) and placed over a flat skin surface (forearm, or, in infants, the thigh). The papers are saturated with 0.2% pilocarpine nitrate and the positive electrode placed over the saturated papers. It is important that the bare metal not touch the skin in order to prevent electrical burns. The negative electrode is liberally coated with EKG paste and placed elsewhere on the extremity. Each electrode is held gently in place by EKG rubber straps.

The instrument is turned on and the current adjusted slowly to 2 milliamperes unless patient discomfort is such that the current need be reduced to 1 to 1.5 ma.

After allowing the current to flow for 5 minutes the positive electrode is removed, the skin rapidly washed 5 times with distilled water and dried thoroughly with gauze sponges.

The weighed ash-free filter paper (obtained from the laboratory) is quickly removed from the weighing bottle with forceps and placed over the skin area previously covered with the positive electrode. This paper is then rapidly covered with a plastic sheet (somewhat larger than the paper) and taped in place with strips of waterproof adhesive tape previously prepared.

After 30 minutes the tape and plastic sheet are removed and the now wet paper is quickly placed in the weighing bottle and immediately returned to the laboratory where the sweat will be leached with appropriate diluents and analyzed for chloride.

- c. Interpretation: Cystic Fibrosis associated with values of > 50 mEq/L. Addison's Disease and Panhypopituitarism may also give abnormally high values.

N.B.: The amount of chloride in the sweat test may be falsely low in children with cystic fibrosis in the face of significant edema.

Ref: Ped. 23:545, 1959.

New Eng. J. Med. 264:13, 1961.

2. Rapid Screening for Cold Agglutinins

a. Method:

1. Collect 4-5 drops of blood in a 60x7 mm Wassermann tube with approximately 0.2 ml of 3.8% sodium citrate solution.
2. Cork tube and place in ice water.
3. After about 30 seconds, tilt tube on its side allowing blood to run down length of tube.
4. Definite floccular agglutination, seen with the naked eye, which disappears on warming to 37° centigrade is considered positive. Use of a control patient makes interpretation easier.

b. Interpretation: Positives correlate with a cold agglutinin titer of 64 or greater.

False positives - almost none.
False negatives - about 2%.

Ref: Ann. Int. Med. 70:701, 1969.

3. Lupus Preparation

- a. Obtain 3-1/2 to 4 cc of whole blood in a heparinized Wassermann tube.
- b. Test must be run within 2 hours of drawing time. The sooner, the better.
- c. Add 5 glass beads to the blood and mix well.
- d. Rotate tube of blood, with the beads in it, for 30 minutes on the Aloe Rotator, or manually.
- e. Spin the entire sample, beads and all, at 1000-1200 rpm, for 10 minutes.
- f. Discard the plasma and lifting the buffy coat carefully, fill a Wintrobe hematocrit and spin it as the sample was spun in step (e). This should produce a large concentrated buffy coat.
- g. Discard the plasma. Gently remove the buffy coat layer and place 1 drop on a coverslip and proceed to pull smears as for peripheral blood differential.
- h. Stain with Wright's for 1 minute and dilute with distilled water for 10-13 minutes.
- i. Mount and examine under low dry, checking when necessary under high dry, for LE cells, rosettes, and extracellular material.

- j. LE cell recognized by presence of relatively smooth, homogeneous, nuclear mass which stains a pale blue color and is less prominent than host nucleus. The latter is compressed to periphery of the cell by the cytoplasmic inclusion. The phagocytic cell is usually a polymorphonuclear leukocyte.

4. Nasal Smear for Eosinophils

- a. Method: Patient is instructed to blow nose, or collect nasal secretions by suction. Smear thinly on glass slide and dry. Stain with Giemsa, Hansel or Wright Stain. Compare number of eosinophils and Neutrophils.
- b. Interpretation:
 - 1. Large numbers of eosinophils suggest allergy.
 - 2. Large numbers of neutrophils suggest infection.
 - 3. Eosinophils and neutrophils suggest chronic allergy with superimposed infection.

NOTE: Large numbers of nasal eosinophils may or may not have coincidental blood eosinophilia; there is no correlation.

Ref: Allergy in Children by Mueller, 1970, Gardner Press.

P A R T II

F O R M U L A R Y



3. 2000 500 km



DRUG INDEX

<u>Trade Name</u>	<u>Generic Name</u>
Achromycin	Tetracycline
Adrenalin	Epinephrine
AEP	AEP
Aerosporin	Polymyxin B
Albumin	Albumin
Aldactone	Spironolactone
Aldomet	Methyldopa
Amethopterin	Methotrexate
Aminophylline	Aminophylline
Ammonium Chloride	Ammonium Chloride
Amytal	Amobarbital
Ansolysin	Pentolinium
Antepar	Piperazine
Apomorphine	Apomorphine
Apresoline	Hydralazine
Aqua-Mephyton	Vitamine K ₁
Aralen	Chloroquine
Aramine	Metaraminol
Aspirin	Acetylsalicylic Acid
Atabrine	Quinacrine
Atarax	Hydroxyzine
Atropine	Atropine
Azulfidine	Salicylazosulfa- pyridine
Belladonna Tincture	Belladonna Tincture
Benadryl	Diphenhydramine
Calcium Chloride	Calcium Chloride
Calcium Gluconate	Calcium Gluconate
Calcium Lactate	Calcium Lactate
Celontin	Methsuximide
Chloromycetin	Chloramphenicol
Chlor-Trimetron	Chlorpheniramine
Cleocin	Clindamycin
Codeine	Codeine
Colace	Diocetyl Sodium Sulfo- succinate
Coly-Mycin	Colistin
Compazine	Prochlorperazine
Corticosteroids	Corticosteroids (see table)
Corticotropin	ACTH
Cosmegen	Actinomycin D
Cuprimine	Penicillamine
Cytomel	Triiodothyronine
Cytosar	Cytosine Arabinoside
Cytosan	Cyclophosphamide
Darvon	Propoxyphene
Declomycin	Demethylchlortetra- cycline
Demerol	Meperidine
Dexedrine	Dextroamphetamine
Diamox	Acetazolamide

Digitalis	Digitalis (see table)
Dilantin	Diphenylhydantoin
Diuril	Chlorothiazide
Dulcolax	Bisacodyl
Dynapen	Dicloxacillin
Edecrin	Ethacrynic Acid
Elixophylline	Theophylline
Ephedrine	Ephedrine
Epsom Salts	Magnesium Sulfate
Equanil	Meprobamate
Erythrocin	Erythromycin
Ferrous Gluconate	Iron Salts
Ferrous Sulfate	Iron Salts
Fungizone	Amphotericin B
Furadantin	Nitrofurantoin
Gantrisin	Sulfisoxazole
Garamycin	Gentamycin
Geopen	Carbenicillin
Glucagon	Glucagon
Grifulvin	Griseofulvin
Hetrazan	Diethylcarbamazine
Hyoscine	Scopolamine
Hyperstat	Diazoxide
Ilosone	Erythromycin
Imferon	Iron Dextran
Imuran	Azathiaprime
Inderal	Propanolol
INH	Isoniazid
Insulin	Insulin (see table)
Ipecac	Ipecac
Ismelin	Guanethidine
Isuprel	Isoproterenol
Kantrex	Kanamycin
Kaon	Potassium Gluconate
Kayexalate	Sodium Polystyrene Sulfonate
Keflex	Cephalexin
Keflin	Cephalothin
Konakion	Vitamin K ₁
Kwell	Gamma Benzene Hexachloride
Lasix	Furosemide
Levophed	Levarterenol
Lincocin	Lincomycin
Liquaemin	Heparin
Luminal	Phenobarbital
Lytic Cocktail	Lytic Cocktail
Magnesium Sulfate	Magnesium Sulfate
Mandelamine	Methenamine Mandelate
Mannitol	Mannitol
Mecholyl	Methacholine

Mercuhydrin
Mesantoin
Methylene Blue
Milk of Magnesia

Miltown
Mintezol
Morphine
Myambutal
Mycostatin
Mysoline

Nalline
Narcan
Nembutal
Neomycin
Neocalglucon

Neo-Synephrine
Noctec

Omnipen
Oncovin

Pamisl
Paraldehyde
Paregoric
PAS
Penicillin
Periactin
Phenergan
Phytonadione
Pilocar
Pitressin
Polycillin
Polycitra
Potassium Chloride
Potassium Gluconate
Potassium Iodide
Potassium Triplex
Povan
Pro-Banthine
Pronestyl
Prostigmin
Protamine
PTU
Purinethol
Pyopen
Pyribenzamine
Pyridium

Quinidine

Regitine
Rimactane
Ritalin
Robaxin

Seconal

Meralluride
Mephenytoin
Methylene Blue
Magnesium Hydroxide
Suspension
Meproamate
Thiabendazole
Morphine
Ethambutol
Nystatin
Primidone

Nalorphine
Naloxone
Pentobarbital
Neomycin
Calcium Glucogalacto-
gluconate
Phenylephrine
Chloral Hydrate

Ampicillin
Vincristine

p-Aminosalicylic Acid
Paraldehyde
Paregoric
p-Aminosalicylic Acid
Penicillin
Cyproheptadine
Promethazine
Vitamin K₁
Pilocarpine
Vasopressin
Ampicillin
Oral Citrate Solution
Potassium Supplements
Potassium Supplements
Potassium Iodide
Potassium Supplements
Pyridinium
Propantheline
Procainamide
Neostigmine
Protamine
Propylthiouracil
Mercaptopurine
Carbenicillin
Tripelethamine
Phenazopyridine

Quinidine

Phentolamine
Rifampin
Methylphenidate
Methocarbamol

Secobarbital

Serpasil
SSKI
Staphcillin
Steroids

Streptomycin
Sudafed
Sulfadiazine
Sus-phrine
Synthroid

Tapazole
Tedral
TegoPen
Temptra
Tensilon
Thiomerin
Thorazine
Thyroid
Tigan
Tinactin
Tofranil
Tridione
Tylenol

Unipen

Valium
Velban
Vibramycin
Vistaril

Xylocaine

Zarontin
Zyloprim

Reserpine
Potassium Iodide
Methicillin
Corticosteroids
(see table)
Streptomycin
Pseudoephedrine
Sulfadiazine
Epinephrine
Levothyroxine

Methimazole
Tedral
Cloxacillin
Acetaminophen
Edrophonium
Mercaptomerin
Chlorpromazine
Thyroid
Trimethobenzamide
Tolnaftate
Imipramine
Trimethadione
Acetaminophen

Nafcillin

Diazepam
Vinblastine
Doxycycline
Hydroxyzine

Lidocaine

Ethosuximide
Allopurinol

DRUG DOSES

109

DRUG	SUPPLIED*	DOSE AND ROUTE	REMARKS
Acetaminophen (Tylenol, Tempra)	Tablets: 325 mg Syrup: 120 mg/5 ml Supp: 600 mg	<1 yr: 60 mg q4-6h PO <3 yr: 120 mg q4-6h PO >3 yr: 120-240 mg q4-6h PO	
Acetazolamide (Diamox)	Tablets: 250 mg Vials: 500 mg	10-30 mg/kg/day PO divided q6-8h	For use in Salicylate poisoning see page
Acetylsalicylic Acid (Aspirin)	Tablets: 75 + 300 mg Supp: 60, 300 + 600 mg	Antipyretic: 30-60 mg/kg/ day PO divided q4-6h Antirheumatic: 100 mg/kg/ day PO divided q4-6h	Use with caution in infants. When used as antirheumatic, follow serum levels and observe for intoxication.
ACTH (Corticotropin)	Aqueous: 40 units/5 ml Gel: 40 + 80 units/ 5 ml	Aqueous: 1.6 units/kg/day IV, IM or SC divided q6-8h Gel: 0.8 units/kg/day divided q12h IM.	Contraindicated in acute psychoses, Cushing's Syndrome, active TBC or peptic ulcer.

*As supplied in the Johns Hopkins Hospital 1972 Formulary

Actinomycin D (Cosmegen)	Vials: 0.5 mg	75 micrograms/kg total dose IV; divided into 5- 10 successive single daily doses (max. single daily dose = 500 micrograms)	Be very careful to avoid any extravasation into sub- cutaneous tissues.
AEP Tablets	Tablets: aminophylline 100 mg ephedrine 16 mg phenobarbital 16 mg (all per tablet)	1 tab/10 kg/day divided q6-8h PO	Dose limited by amino- phylline content of tablet.
Albumin	Vials: 5 gm/20 ml 25 gm/100 ml	0.5-1.0 gm/kg/dose IV	Use with caution in hyper- volemic states
Allopurinol (Zyloprim)	Tablets: 100 mg	10 mg/kg/day divided q8h PO	Use in children limited to hyperuricemia of malignancies. Establish alkaline urine flow.
Aminophylline	Ampules: 25 mg/ml (10 ml ampule) Tablets: 100 + 200 mg Supp: 125, 250 + 500 mg	3-4 mg/kg/dose IV, PO or PR q8h PRN. (Max. dose = 12 mg/kg/day)	Potentiates effect of epinephrine. IV infusion over 5-15 minutes.

Ammonium Chloride	Tablets: 500 mg Vials: 4 mEq/ml	75 mg/kg/day PO divided q6h 2-6 gm/day PO for diuresis or acidification of urine.	Continued use may cause acidosis. Use with caution in infants or in liver disease.
Amobarbital (Amytal)	Tablets: 30, 50 + 100 mg Capsules: 200 mg Ampules: 250 + 500 mg	Sedation: 6 mg/kg/day PO divided q8h	Use with caution in hepatic disease, CNS or respiratory depression.
Amphotericin B (Fungizone)	Vials: 50 mg	Test Dose: 0.1 mg/kg on first day of therapy IV over 6 hours. Then.. Increase To: 1 mg/kg/day IV as single infusion over 6-8 hours.	Do not use if precipitate present in solution. Local and systemic reactions common. Follow hepatic, renal, and hematopoietic indices closely.
Ampicillin (Polycillin, Omnipen)	Capsules: 250 + 500 mg Susp: 125 + 250 mg/ 5 ml Vials: 250, 500 mg + 1 gm	50-400 mg/kg/day PO, IM, or IV divided q6h (Max. dose = 6-8 gm/day)	Same side reactions as penicillin, with allergic cross-reactivity. 2.7 mEq Na/gm ampicillin.
Apomorphine	Vials: 10 mg/ml	Emetic Dose: 0.1 mg/kg/dose IM or SC	Decomposed solution turns green. Use cautiously in sedated patients.

Atropine	Tablets: 0.32, 0.4 + 0.65 mg Vials: 1 mg/ml Ophthalmic Solution: 0.5, 1 + 3% Ophthalmic Ointment: 1%	0.01 mg/kg/dose PO or SC q4-6h PRN (Max. single dose = 0.4 mg)	Children with Down's Syndrome may be hyper- sensitive. Contraindicated in glaucoma. See PRE- ANESTHETIC MEDICATION on page 159.
Azathiaprine (Imuran)	Tablets: 50 mg	Initial: 3-5 mg/kg/day PO Maintenance: may be re- duced to 1-2 mg/kg/day PO according to patient's response.	Blood dyscrasias not infre- quent. Follow hematologic, GI, and hepatic function closely, especially in pre- sence of renal disease.
Belladonna Tincture	Dropper Bottles: 30 + 60 ml (1 ml approximately = 0.3 mg atropine)	0.1 ml/kg/day PO divided q6-8h (Max. total dose = 3.5 ml/day)	Toxicity same as atropine.
Bisacodyl (Dulcolax)	Tablets: 5 mg (enteric) Supp: 10 mg	0.3 mg/kg/dose PO 6 hours before desired effect.	Do not chew tablets. Not recommended for newborn.
Calcium Chloride (27% calcium)	Ampules: 10% (100 mg/ml) (14 mEq/gm salt: 73 mg salt/mEq)	250-300 mg/kg/day PO as 2% solution divided q6h	Irritating IV and on GI tract. Acidifying: give 2-3 days then change to another salt.

Calcium Gluconate (9% calcium)	Tablets (gluconate): 1 gm Ampules (gluconate): 10% (100 mg/ml) (4 mEq Ca/gm salt: 224 mg salt/mEq Ca) Syrup (Neocalglucon): 4 ml = 1 gm Ca gluconate (90 mg Ca/gm salt)	500 mg/kg/day PO in divided doses. 200 mg/kg/dose IV slowly.	If given IV, watch for bradycardia and extra- vasation and MONITOR.
Calcium Glucogal- actogluconate (Neocalglucon)			
Calcium Lactate (13% calcium)	Tablets: 600 mg (6 mEq Ca/gm salt: 154 mg salt/mEq Ca)	500 mg/kg/day PO in divided doses	Tablets do not dissolve in milk.
Carbenicillin (Geopen, Pyopen)	Vials: 1 + 5 gm	200-500 mg/kg/day IM or IV divided q4h	Interaction with gentamycin unpredictable IV. Rapid resistance when used alone.
Cephalexin (Keflex)	Capsules: 250 mg Oral Susp: 125 mg/5 ml	25-50 mg/kg/day PO divided q6h (Max. dose = 4 gm/day)	GI disturbances frequent. Cross sensitivity with penicillins.
Chloral Hydrate (Noctec)	Capsules: 250 + 500 mg Syrup: 500 mg/5 ml Supp: 300, 600 mg + 1 gm	10-20 mg/kg/dose PO or PR repeat q6-8h PRN. Max. total dose = 50 mg/ kg/day PO or PR) (Max. single dose: 2.0 gm PO or PR)	Irritating to tracheo- bronchial membranes; may cause laryngospasm if aspirated.

Chloramphenicol (Chloromycetin)	Capsules: 100 + 250 mg Susp: 150 mg/5 ml Vials: 1 gm Otic solution: 0.5% Ophthalmic solution: 0.16, 0.25, 0.5% Ophthalmic ointment: 1%	Prematures and Newborns: 25 mg/kg/day PO, IM or IV Infants > 2 wks: 50 mg/kg/day PO, IM or IV Children: 50-100 mg/kg/day PO, IM or IV All divided q6h	Adjust newborn dose according to blood levels (10-20 micrograms/ml). Follow hematologic status carefully.
Chloroquine Phosphate (Aralen)	Tablets: 250 mg	Amebic Hepatitis: Initial dose: 2 mg/kg/day PO divided by q12h for 2 consecutive days. Maintenance dose: 1 mg/kg/day PO as single daily dose for 2 to 3 weeks. Malaria: see standard reference works.	Numerous toxic side effects. Severe infections and hepatic abscess may require higher doses.
Chlorothiazide (Diuril)	Tablets: 250 + 500 mg Susp: 250 mg/5 ml Vials: 500 mg	Infants < 6 mos: 20-30 mg/kg/day PO Children > 6 mos: 20 mg/kg/day PO divided q12h	Use with caution in liver and severe renal disease. Follow electrolytes. May cause hyperbilirubinemia and hyperglycemia.
Chlorpheniramine (Chlor-Trimeton)	Tablets: 4 mg Repetabs: 8 + 12 mg Syrup: 2.5 mg/5 ml Injection: 100 mg/ml	0.35 mg/kg/day PO or SC divided q6h	Usual side effects of antihistamines; use with caution in presence of other depressants.

Chlorpromazine (Thorazine)	Tablets: 10, 25, 50 + 100 mg Spansules: 30, 75, 150, 200 + 300 mg Syrup: 10 mg/5 ml Supp: 25 + 100 mg Oral Concentrate: 30 mg/ml Ampules: 25 mg/ml	2 mg/kg/day PO or IM divided q6h PRN	Extrapramidal symptoms, especially diskinctic reactions, common. May potentiate effects of narcotics, sedatives, and other drugs. SEE LYTIC COCKTAIL on page 127.
Clindamycin (Cleocin)	Capsules: 75 + 150 mg Oral Liquid: 75 mg/5 ml	8-20 mg/kg/day PO divided q6-8h	Not indicated for infants and newborns.
Cloxacillin (TegoPen)	Capsule: 250 mg Oral solution: 125 mg/5 ml	50-200 mg/kg/day PO divided q6h (max. dose = 6-8 gm/day)	Same side reactions as penicillins. Better absorbed PO than oxacillin.
Codeine	Tablets: 15, 30 + 60 mg Ampules: 30 + 60 mg Elixir terpin hydrate and codeine: 10 mg codeine/5 ml	Pain: 0.5-1.0 mg/kg/dose PO or SC, repeat q4-6h PRN (usual total daily dose = 3 mg/kg/day) Cough: 0.2 mg/kg/dose PO repeat q4h PRN	May be habit forming.

Colistin (Coly-Mycin)	Oral Susp: 25 mg/5 ml Vials: 150 mg	<u>Enterocolitis: 5-15 mg/kg/day PO divided q8h</u> <u>Systemic: 1.5-5.0 mg/kg/day deep IM divided q6-12h</u>	Use with caution in presence of renal disease. May be neurotoxic.
Corticosteroids	See following table on page 156.		
Cyclophosphamide (Cytosan)	Tablets: 50 mg Vials: 100, 200 + 500 mg	<u>Daily Therapy: 2.5 mg/kg/day PO single daily dose</u> <u>Intermittent Therapy: dosage varies widely; generally following range: 10-20 mg/kg/dose PO or IV single weekly dose.</u>	Higher dosages to be used only with experimental protocols. Maintenance dose titred against hematologic status and tumor response. Numerous complications.
Cycloheptadine (Periactin)	Tablets: 5 mg Syrup: 2 mg/5 ml	0.25 mg/kg/day PO divided q6-8h	
Cytosine Arabinoside (Cytosar)	Vials: 100 + 500 mg	<u>Initial: 2 mg/kg/day IV push OR 0.5-1.0 mg/kg/day IV by slow infusion over 1-24 hours</u> <u>Maintenance: 1 mg/kg/dose SC twice weekly (numerous alternate experimental schedules)</u>	Toxicity pervasive. Should only be used by experienced personnel under careful supervision. Use with caution in presence of infection. Safety in infants not established.

Demethylchlor- tetracycline (Declomycin)	Tablets: 300 mg Capsules: 150 mg Syrup: 75 mg/5 ml	10 mg/kg/day PO divided q6-12h	See Tetracycline.
Dextroampheta- mine (Dexedrine)	Tablets: 5 mg Elixir: 5 mg/5 ml Spansule: 10 + 15 mg	2-15 mg/day PO divided into 2 or 3 doses or as single sustained-action dose	Use with caution in pre- sence of hypertension or cardiovascular disease.
Diazepam (Valium)	Tablets: 2, 5, + 10 mg Ampules: 5 mg/1 ml	<u>Sedative & Chronic Anti- convulsant:</u> 0.1-0.8 mg/ kg/day PO divided q6-8h; 0.04-0.20 mg/kg/dose IM or IV slowly, repeat q2-4h PRN <u>Acute Anticonvulsant:</u> Give by slow IV infusion enough to stop seizure in 1-3 mg (or 1/4 of total dose) increments q3-5 min. (Max. dose = 5 mg in infants and small children and 15 mg in older children)	Use with caution in glau- coma, shock, and severely depressed patients. Acute discontinuation may cause withdrawal symptoms 48-72 hours later.

Diazoxide (Hyperstat)	Ampules: 300 mg	<u>Hypertensive Crisis:</u> 2-10 mg/kg/dose, rapid IV push, PRN (usually 5 mg/ kg IV q2-5h)	May cause hyperglycemia, ketoacidosis, GI distur- bances, arrhythmias, hypo- natremia (all rare). Not yet released for children.
Dicloxacillin (Dynapen)	Capsules: 125 + 250 mg Oral Susp: 62.5 mg/5 ml	25-100 mg/kg/day PO divided q6h (dosage in newborn not established)	Allergic cross-sensitivity with penicillin. Similar toxicity and side effects to cloxacillin.
Diethylcarba- mazine (Hetrazan)	Tablets: 50 mg Syrup: 120 mg/5 ml	Ascariasis: 15 mg/kg/day PO as single daily dose for 4 consecutive days.	
Digitalis	See following table on pages 152 and 160.		
Diethyl Sodium Sulfosuccinate (Colace)	Capsules: 50 + 100 mg Solution: 10 mg/ml Syrup: 20 mg/5 ml	5 mg/kg/day PO divided q6-8h	
Diphenhydramine (Benadryl)	Capsules: 25 + 50 mg Elixir: 12.5 mg/5 ml Ampules: 50 mg/ml Vials: 10 mg/ml	5 mg/kg/day PO or IM divided q6h (Max. total dose = 300 mg/day)	Side effects common to antihistamines.

Diphenylhydantoin (Dilantin)	Capsules: 30 + 100 mg Tablets: 50 mg Susp: 125 mg/5 ml Vials: 20 + 50 mg/ml	5-7 mg/kg/day PO or IM (use with caution IV) divided into one or two daily doses.	Side reactions include gingival hyperplasia, dermatitis, blood dys- crasias, ataxia, lympho- adenopathy and liver damage.
Doxycycline (Vibramycin)	Capsules: 50 + 100 mg Oral Solution: 125 mg/ 5 ml	Initial: <45 kg: 5 mg/ kg/day PO divided q12h. >45 kg: 200 mg/day PO divided q12h Maintenance: <45 kg: 2.5 mg/kg/day PO single daily dose. >45 kg: 100 mg/day PO single daily dose.	Hepatic toxicity reported. Use with caution in renal disease.
Edrophonium (Tensilon)	Ampules: 10 mg/ml	0.2 mg/kg/dose IV (Max. total dose 5-10 mg). Give 1/5 of test dose IV slowly, if no response in 1 minute, give additional 1 mg increments.	Keep atropine available in syringe. May precipitate cholinergic crisis, arrhythmias, and broncho- spasm. Not recommended for infants.
Ephedrine	Tablets: 25 + 50 mg Syrup: 4 mg/ml Capsules: 25 + 50 mg Ampules: 50 mg/ml	0.5-1.0 mg/kg/dose PO or SC. 0.2 mg/kg/dose IM. Repeat q4-6h PRN (Max. daily dose = 3 mg/kg)	May precipitate arrhythmias and potentiate theophylline. IV Drip = 50 mg/1000 ml, adjust rate to patient's response.

Epinephrine (Adrenalin)	1:1000 (Aqueous) Ampules: 1 ml (1 mg/ml) Vials: 30 ml (1 mg/ml) 1:500 (in oil) Ampules: 1 ml (2 mg/ml) 1:2000 (Suscprine) Vials: 5 ml (5 mg/ml)	1:100 (Aqueous): 0.01 ml/kg/dose SC (Max. single dose = 0.5 ml), repeat q15-20 minutes x 3-4 or q4h PRN 1:500 (In Oil): 0.01-0.02 ml/kg/dose IM, repeat q12-24h PRN 1:200 (Suscprine): 0.004 ml/kg/dose SC, repeat q8-12h PRN	May produce arrhythmias.
Erythromycin Salts (Erythrocin, Ilosone)	Erythromycin: Tablets: 125 + 250 mg Erythromycin Ethyl Succinate: Suspension: 200 mg/5 ml Erythromycin Lactobionate: Vials: 500 mg + 1 gm Erythromycin Estolate (Ilosone): Capsules: 125 + 250 mg Susp: 125 mg/5 ml	Erythromycin + Salts: Oral: 30-50 mg/kg/day divided q4-6h Parenteral: 10 mg/kg/day IM or IV divided q8-12h Erythromycin Estolate: Oral: <11 kg 40-80 mg/ kg/day; 11-23 kg 500 mg-1 gm/day; >23 kg 1-2 gm/day all divided q6h. Children: 25 mg/dose PO, 0.5-1 mg/kg/dose IV	GI side effects common. Use with caution in liver disease. Rheumatic Fever Prophylaxis: 200 mg/day PO.
Ethacrynic Acid (Edecrin)	Tablets: 25 + 50 mg Vials: 50 mg		Ototoxicity may occur in renal disease. Caution in liver disease and severe cardiac disease.

Ethambutol (Myambutol)	Tablets: 100 + 400 mg	15-25 mg/kg PO, as single daily dose.	Follow visual acuity.
Ethosuximide (Zarontin)	Capsules: 250 mg	Initial Dose: ≤ 6 years: 250 mg/day PO as single dose > 6 years: 500 mg/day PO divided q12h Subsequent Dose: increase by 250 mg increments q4-7 days.	Caution in liver and renal disease. May cause blood dyscrasias, GI, neurologic, and dermatologic reactions. Increase as necessary to control symptoms short of significant side effects.
Furosemide (Lasix)	Tablets: 40 mg Ampules: 10 mg/ml	0.5-1 mg/kg/dose PO, IM, or IV	Ototoxicity may occur in renal disease. Give with caution in hepatic disease.
Gamma Benzene Hexachloride (Kwell)	Shampoo: 1% (60cc bottle) Lotion: 1%	Shampoo with 30cc; repeat in 24 hours.	For pediculosis.
Gentamycin (Garamycin)	Vials: 40 mg/ml	3-5 mg/kg/day IM or IV (slowly over 30 min.) (Higher doses may be used in meningitis)	Use only for life-threatening infections in infants and newborn. Monitor closely for renal and ototoxicity. Follow with serum levels.

Glucagon	Ampules: 1 mg/ml	General Causes of Hypoglycemia: 0.025-0.03 mg/kg/dose SC, IM, or IV. May repeat q20 min PRN (max. total dose = 1 mg) Symptomatic Infants of Diabetic Mothers: 0.30 mg/kg/dose SC, IM or IV.	Do not rely on glucagon alone to correct prolonged or profound hypoglycemia in newborns; use glucose IV.
Griseofulvin (Grifulvin) Griseofulvin Microcrystalline (Grifulvin V)	Griseofulvin: Susp: 250 mg/5 ml Griseofulvin microcrystalline: Tablets: 250 + 500 mg	Griseofulvin: 20 mg/kg/day PO divided q6-12h Griseofulvin microcrystalline: 10 mg/kg/day PO divided q6-12h.	Contraindicated in porphyria and severe hepatic disease. Absorption improved if taken with milk.
Guanethidine (Ismelin)	Tablets: 10 + 25 mg	0.2 mg/kg/day PO as single daily dose; increase as necessary q7-10 days by 0.2 mg/kg/day increments.	Contraindicated in pheochromocytoma or presence of MAO inhibitors. Caution in renal, CNS, or cardiovascular disease.
Heparin (Liquaemin)	Vials: 1000 + 10,000 units/ml heparin injection: 20,000 units/ml (120 units = approximately 1 mg)	Initial Dose: 50 units/kg IV drip Maintenance Dose: 100 units/kg/dose IV drip, repeat q4h.	Titrate dose to give clotting time of 20-30 minutes or 2-3 times normal, immediately before each dose. <u>Antidote:</u> Protamine Sulfate.

Hydralazine (Apresoline)	Tablets: 10, 25, 50 + 100 mg Ampules: 20 mg/ml	Oral: 0.75 mg/kg/day divided q6h (may increase slowly over 3-4 wks. to Max. dose of 7.5 mg/kg/ day) Parenteral Alone: 1.7-3.5 mg/kg/day IM or IV divided q4-6h Parenteral with Reserpine: 0.15 mg/kg/dose IM or IV q12-24h.	Use with caution in severe renal disease. May cause lupus and arthritic-like syndromes.
Hydroxyzine Salts (Atarax, Vistaril)	Tablets: 10 mg (hydro- chloride) Capsules: 25 + 50 mg (pamoate) Syrup: 25 mg/5 ml (pamoate) Vials: 50 mg/ml (hydrochloride)	2 mg/kg/day PO divided q6-8h	May potentiate barbiturates, meperidine, and other depressants.
Imipramine (Tofranil)	Tablets: 10, 25 + 50 mg Vials: 12.5 mg/ml	Sedative: 1.5 mg/kg/day PO or IM divided q6-8h Enuresis: 10-50 mg PO qhs	Caution in presence of glaucoma, cardiac arrhythmias, MAO inhibitors.
Insulin	See following table on page 154.		

Ipecac, syrup	Syrup: 0.14% alkaloids	1 Year: 15 ml PO followed with water; may repeat in 15-20 minutes once if needed.	NEVER use FLUID EXTRACT of Ipecac. May be fatal.
Iron Dextran (Imferon)	Ampules: 2 ml Vials: 10 ml (50 mg elemental Fe/ml)	Total Dose in mg Fe: Surface area (M²) x 55 x (13.5-Hgb in gm%) = mg Fe needed IM. May add 10-50% for stores. Give 1-2 ml/day until total dose given.	Use "Z" technique of IM administration. Numerous side effects and toxic reactions including anaphylaxis. Inject test dose of 0.1-0.2 ml the first day.
Iron Salts	Ferrous Sulfate: Oral Liquid (drops) - (Fer-in-Sol): 125 mg FeSO₄/ml = 25 mg Fe/ml Syrup (elixir) - (Feosol): 40 mg FeSO₄/ ml = 8 mg Fe/ml Tablets: 300 mg FeSO₄ - 60 mg Fe Ferrous Gluconate: (Fergon) Oral liquid (elixir): 60 mg Fe gluconate/ml = 7 mg Fe/ml Tablets: 300 mg Fe gluconate = 35 mg Fe	Treatment: 6 mg Fe/kg/day PO divided q8h Prophylaxis: Prematures, newborns, and infants predisposed to anemia: 8-15 mg Fe/day PO divided q8-12h for first 6-12 months of life. Older Infants and Children: 1 mg Fe/kg/day PO single or divided doses.	Ferrous salts better absorbed than ferric salts.

Isoniazid (INH)	Tablets: 100 mg Syrup: 50 mg/5 ml Ampules: 100 mg/ml	Therapeutic: 15-20 mg/kg/day PO or IM divided q8-12h (total max. dose = 300-500 mg/day) Prophylactic: 10 mg/kg/day PO divided q8-12h or single daily dose if tolerated (total max. dose = 300 mg/day)	CNS and hepatic side effects not infrequent with high dosages. Slow acetylators more likely to develop toxicity. Supple- ment adolescents with pyridoxine.
Isoproterenol (Isuprel)	Tablets: 10 + 15 mg Elixir: 2.5 mg/15 ml Nebulizer: 1:400 Ampules: 1:5,000 (5 ml)	Sublingual: 5-10 mg/dose PO repeat q6-8h PRN Rectal: 5-10 mg/dose PR repeat q6-8h PRN IV Infusion: 0.05-4.0 micrograms/minute; adjust rate to patient's response (1 ampule = 1 mg; therefore 1 ampule in 1 liter D5W = 1 micro- gram/ml)	Use with care in presence of congestive failure. May cause arrhythmias in combination with epine- phrine.

Zanamydin (Zantrex)	Capsule: 566 mg Vials: 75 mg/2 ml 500 mg/2 ml 1000 mg/3 ml	Enteric: 56 mg/kg/day PO divided q6h Systemic: Premature and Infants <1 year: 15 mg/kg/day IM divided q12h Older children: 6-15 mg/kg/day IM divided q4h.	Renal and auditory toxicity frequent. Avoid IV use.
Desferrioxamine Bioscience (Desferal)	Ampules: 2 mg/ml Concentration: 10, 20, 40	IV Infusions: 1 ampule in 4 ml 1% mg/ml solution 100 mg/1 liter (100 mg/100 microgram/ml). Test dose 0.2 micrograms/kg; follow by titrating dose with positive BP. Usual rate of administration: 0.5-1.0 ml (4-8 micro- grams)/minute.	Treatment for extrapyramidal manifestations, 5-15 mg IM 1-2 ml 100 mg, and 100 mg IM daily.
Levothyroxine (Synthroid)	Tablets: 50, 100, 200 + 300 micrograms Vials: 500 micrograms	Calculate dosage as for desiccated thyroid according to following equivalent: 5 grain 65 mg USP desiccated thyroid = 100 micro- grams levothyroxine.	See Thyroid.

Local anesthetic (N/A, 100 mg)	Viols: 0.5, 1, 2, 3, 4, 5 + 50 (50 ml) (1% solution = 10 mg/ml) Ointment: 2.5 + 50 (1% + 50 mg/ml) Gel: (100 ml) Jelly: 20 (30 ml tubes)	Anesthetic: apply or infiltrate locally PRN (max. total dose 3-5 mg/kg) Adjuvant: 1% solution 0.5-1.0 mg/kg slowly may repeat q5-10 min PRN. Continuous IV infusion: 20-30 mg/kg/hr (max. total dose 5 mg/kg)	Topical administration may cause allergic reaction. Irritation. Side effects of IV administration may include hypotension, tachycardia, arrhythmia, and respiratory arrest.
Antiemetic (N/A, 100 mg)	Capsules: 250 + 500 mg Syrup: 250 mg/5 ml Viols: 300 mg/ml	Oral: 30-60 mg/kg/day divided q8-12h Intravenous: 10-20 mg/kg day single dose or divided q12h Intravenous: 10-20 mg/kg day divided q8-12h	Contraindicated in infants under 1 month of age. Use with caution in presence of liver or renal disease.
Lytic Cocktail (DPT)		Anesthetic: Phenylephrine: 2 mg/kg Propofol: 1 mg/kg Atorazine: 1 mg/kg (max. dose = 50 mg Demerol)	Nix in one syringe and give deep IM.

Magnesium Hydroxide Suspension (Milk of Magnesia)	USP magma (milk): 8% magnesium hydroxide	0.5 mL/kg/dose PO	
Magnesium Sulfate	Ampules: 500 mg/mL (2 mL) Oral Solution: 50% (Espom salts)	<u>Cathartic:</u> 250 mg/kg/dose PO <u>Hypertension:</u> IM: 50% solution (500 mg/mL) 0.2 mL/kg/dose repeat q4-6h PRN IV: 1% solution (10 mg/mL) (max: 100 mg/kg/dose slowly)	Monitor blood pressure and respirations. Calcium gluconate (IV) should be available as antidote.
Mannitol	Vials: 250 mg/mL (25%)	<u>Test Dose:</u> 200 mg/kg IV single dose over 3-5 min. <u>Edema:</u> (15-20% solution) Ascites or generalized: 1-2 g/kg IV as slow infusion over 2-6h. Cerebral or Ocular: 1-2 g/kg IV over 30-60 mins.	May cause circulatory overload and electrolyte disturbances.

Meperidine (Demerol)	Tablets: 50 mg Elixir: 50 mg/ml Vials: 50 + 100 mg/ml	6 mg/kg/day PO, IM, or SC divided q4-6h PRN (max. single dose = 50-100 mg/ dose)	Contraindicated in cardiac arrhythmias, increased intracranial pressure, and asthma. Potentiated by MAO inhibitors, pheno- thiazines, isoniazid, other CNS acting agents. 75 mg Demerol = 10 mg Morphine.
Mephenytoin (mesantoin)	Tablets: 100 mg	3-15 mg/kg/day PO divided q8h.	May cause blood dyscrasias.
Meprobamate (Equanil, Miltown)	Tablets: 400 mg Susp: 200 mg/5 ml	25 mg/kg/day PO divided q8-12h	Do not discontinue abruptly because of danger of with- drawal symptoms.
Meralluride (Mercurhydrin)	Ampules: 130 mg/ml (1 ml contains 39 mEq Hg + 48 mg theophylline)	4-6 mg/kg/day or approxi- mately: <15 kg : 0.04 ml/kg/day 15-35 kg: 0.03 mg/kg/day >35 kg : 1-2 ml/day IM, as single dose, usually q2-3 days. May be given no more often than once daily (max. dose = 2 ml)	May require K+ supplementa- tion. Contraindicated in oliguria and nephritis.

Mercaptomerin (Thiomerin)	Vials: 125 mg/ml (1 ml contains 40 mg Hg)	As for meralluride.	As for meralluride.
Mercaptapurine (Purinethol)	Tablets: 50 mg	2.5 mg/kg/day PO as single daily dose	Reduced excretion with renal disease. Dosage <u>must</u> be reduced by 25-50% when <u>used with allopurinol</u> .
Metaraminol (Aramine)	Vials: 10 mg/ml (10 ml)	IM: 0.1 mg/kg/dose IM or SC as single dose PRN IV Single Dose: 0.01 mg/ kg/dose IV PRN Continuous Infusion: 1 ml/250 ml D5W or NS; adjust rate to maintain blood pressure. (Max. total dose = 0.4 mg/kg)	Use with caution during cyclopropane anesthesia, in thyrioid or heart disease, or in diabetes.
Methacholine (Mecholyl)	Ampules: 25 mg	0.1-0.4 mg/kg SC or IM as single dose; may increase by 25% q30 min.	Contraindicated in asthma, intestinal or bladder neck obstruction. May cause cholinergic crisis. Keep atropine available.

Methenamine Mandelate (Mandelamine)	Tablets: 250, 500 + 1,000 mg Susp: 500 mg/5 ml	Initial Dose: 100 mg/kg/ day PO divided q8h Maintenance Dose: 50 mg/ kg/day PO divided q8h (max. total dose = 3 gm/day)	Contraindicated in renal insufficiency. Maintain urine acidity below pH 5.5
Methicillin (Staphicillin)	Vials: 1 gm	100-400 mg/kg/day IM or IV divided q4-6h Newborn: 100 mg/kg/day IM or IV divided q4-6h	Allergic cross-reactivity with and same toxicity as penicillin. May cause hematuria.
Methimazole (Tapazole)	Tablets: 5 + 10 mg	Initial: 0.4 mg/kg/day PO divided q8h Maintenance: 0.2 mg/kg/day PO divided q8h (average dose)	May cause blood dyscrasias, dermatitis, hepatitis, CNS reactions, arthralgia, or hypothyroidism. Follow thyroid function. 10 mg Tapazole = 100 mg PTU.
Methocarbamol (Robaxin)	Tablets: 500 mg Ampules: 100 mg/ml	15 mg/kg/dose PO, IM, or IV q6h PRN (max. single dose = 1 gm IM or IV) (Max. IV dosage rate = 3 mg/min.)	Dose may be increased in treating tetanus. Avoid extravasation. May cause hypotension.

Methotrexate (Amethopterin)	Tablets: 2.5 mg Vials: 5 + 50 mg	15-30 mg/M2/dose PO twice weekly Intrathecal: 0.5 mg/kg or 12 mg/M2 as single dose, repeat at 3-5 day intervals for active disease.	Antidote: Calcium leucovorin. IM or IV dosage variable with experimental protocols. Use with caution in presence of renal disease.
Methsuximide (Celontin)	Capsules: 150 + 300 mg	Initial: 300 mg/day PO as single dose Increase: 300 mg/day increments/week PRN (max. total dose = 1.2 grams)	May cause blood dyscrasias, GI, CNS symptoms, and behavioral changes.
Methylodopa (Aldomet)	Tablets: 250 mg Ampules: 50 mg/ml	Oral: 10 mg/kg/day PO divided q8-12; increase PRN at 2 day intervals Intravenous (crises): 20-40 mg/kg/day IV divided q6h (max. total dose = 65 mg/kg/day)	Contraindicated in pheochromocytoma and active hepatic disease. Follow liver function and hematologic status.
Methylene Blue	Ampules: 10 mg/ml (1%)	Methemoglobinemia: 1-2 mg/kg/dose IV over 5 minutes	

Methylphenidate (Ritalin)	Tablets: 5 + 10 mg	Hyperactivity: 0.25-2 mg/ kg/day PO divided into 2 or 3 doses	Contraindicated in epilepsy and glaucoma. May interact with pressors.
Morphine	Vials: 8, 10 + 15 mg/ml	Analgesia: 0.1-0.2 mg/kg/ dose SC repeat q4h PRN tetralogy (cyanotic) Spells: 0.2 mg/kg/dose SC repeat q4h PRN (max. total dose = 15 mg/dose)	For respiratory depression secondary to morphine over- dose see Naloxone or Nalorphine.
Nafcillin (Unipen)	Capsule: 250 mg Vials: 250 mg/ml	Newborn: 40 mg/kg/day PO divided q6h; 20-40 mg/ kg/day IM divided q12h Older Infants & Children: 25-50 mg/kg/day PO divided q6h; 50-100 mg/ kg/day IM divided q12h, or IV q4h	Allergic cross-sensitivity with penicillin.
Nalorphine (Nalline)	Ampules: 0.2 + 5 mg/ml	0.1 mg/kg/dose IV or IM repeat q15 minutes PRN	Will cause increased CNS and respiratory depression if primary depression not due to narcotic.

Naloxone (Narcan)	Ampules: 0.4 mg/ml	5-10 micrograms/kg/dose IM or IV repeat q2-3 minutes PRN x 3	No respiratory depression. Experience in infants and children limited.
Neomycin	Tablets: 500 mg Vials: 500 mg	Prematures & Newborns: 50 mg/kg/day PO divided q6h Infants & Children: 100 mg/kg/day PO divided q6h	Contraindicated in intestinal obstruction and ulcerative bowel disease. Follow for signs of renal or ototoxicity.
Neostigmine (Prostigmin)	Tablets: 15 mg Ampules: 0.25 + 0.5 mg/ml Vials: 1 mg/ml	2 mg/kg/day PO divided q3-4h Myasthenia Gravis Test: 0.04 mg/kg/dose IM 0.02 mg/kg/dose IV	Contraindicated in intestinal and urinary obstruction. May cause cholinergic crisis. Keep atropine available.
Nitrofurantoin (Furadantin)	Tablets: 50 + 100 mg Susp: 25 mg/5 ml	5-7 mg/kg/day PO divided q6h	Dosage may require reduction in prolonged use (> 2 weeks). Contraindicated in severe renal disease, G6PD deficiency, and in infants < 1 mo. of age.

Nystatin (Mycostatin)	Tablets: 500,000 units Susp: 100,000 units/ml Topical powder, cream, ointment: 100,000 units/gm	Premature & Newborn Infants: 400,000 units/day PO divided q6-8h Older Infants & Children: 1-2 million units/day PO divided q6-8h	May produce diarrhea or GI symptoms.
Oral Citrate Mixture (Polycitra)	Syrup: 1 ml contains 2 mEq citrate, 1 mEq Na, and 1 mEq K.	5-20 ml/dose PO q6-8h	Adjust dosage to maintain desired urine pH.
PAS, p-Amino-salicylic Acid (Pamisyl)	Resin: 50% (acid) Powder: (Na salt) Tablets: (Ca + Na + K salts) Tablets, enteric coated: 500 mg (acid)	300 mg/kg/day PO divided q8h (max. total dose = 12 gm/day)	May cause hepatic damage, GI symptoms, renal damage, and hypothyroidism. 1 gm Na salt = 109 mg Na
Paraldehyde	Ampules: 1 gm/ml (5 ml) Oral Solution: 1 gm/ml (5 ml)	Sedative: 0.15 ml (150 mg)/kg/dose PO, IM, or PR in equal amount of oil Anticonvulsant: 0.15 ml (150 mg)/kg/dose deep IM or slowly IV (may dilute with D5W) or 0.3 ml (300 mg)/kg/dose PR in oil (max. dose = 8 ml)	Do not use discolored solution. Avoid plastic syringes (use glass - it dissolves plastic). Contraindicated in hepatic or pulmonary disease. Overdose may cause cardio-respiratory depression.

Paregoric (Camphorated Opium Tincture)	Tincture: 2 mg/5 ml (0.4 mg morphine/ml)	Analgesic: 0.25-0.5 ml/kg/ dose PO repeat q3-4h PRN (max. dose = 0.5 ml/kg)	Same side effects as morphine.
Penicillamine (Cuprimine)	Capsules: 250 mg	Infants < 6 mos.: 250 mg PO single daily dose Older Infants & Children: 1 gm/day PO divided q6h. Increase gradually based on clinical response and heavy metal excretion (max. dose = 4-5 gm/day)	May cause blood dyscrasias, nephrotic syndrome, liver and skin disorders, cataracts and optic neuritis.
Penicillin G	Potassium salt: (Pentids) Tablets: 200,000 + 400,000 units Oral Liquid: 200,000 + 400,000 units/5 ml Vials: 1, 5 + 20 million units Sodium Salt: Vials: 1 + 5 million Benzathine: (Bicillin) Tablets: 200,000 units Vials: 300,000 + 600,000 units/ ml Procaine: (Crysticillin, Duracillin): Vials (aqueous): 500,000 units/ml	Na + K Salts: Premature & Newborn: 50,000 units/kg/day IM or IV divided q12h Children: 25,000-300,000 units/kg/day PO, IM, or IV divided q4-6h Benzathine: 0.3-1.2 million units/dose IM. Do not use in newborn. Procaine: 0.3-1.2 million units/day IM single daily dose. Do not use in newborn. Rheumatic Fever Prophylaxis: 400,000 units/day PO divided q12h OR 1.2 million units Benzathine IM once monthly.	K salt: 1 mg = 1,595 units. 1 million units contains 1.68 mEq (65.8 mg) K+ Na salt: 1 mg = 1,667 units. 1 million units contains 1.68 mEq (38.7 mg) Na+ Benzathine: 1 mg = 1,211 units Procaine: 1 mg = 1,009 units.

Penicillin V	<u>Phenoxymethyl Penicillin:</u> Capsules: (V-Cillin) 250 mg (400,000 units) Tablets: (Pen Vee) 125 + 300 mg (200,000 + 500,000 units) <u>Phenoxymethyl Penicillin</u> Potassium: (Pen Vee K, V-Cillin K) Tablets: 125 + 250 mg (200,000 + 400,000 units) Oral Solution: 125 + 250 mg/5 ml	Children: 25,000-50,000 units/kg/day PO divided q6h Rheumatic Fever <u>Prophylaxis:</u> 250 mg (400,000 units)/day PO divided q12h	<u>Phenoxymethyl:</u> 1 mg = 1,695 units K Salt: 1 mg = 1,530 units
Pentobarbital (Nembutal)	Capsules: 30, 50 + 100 mg Elixir: 20 mg/5 ml Supp: 30, 60, 120, + 200 mg Ampules: 50 mg/ml Vials: 50 mg/ml	Sedation: 2-3 mg/kg/dose PO, IM, or PR; repeat q8h PRN	No advantage over pheno- barbital for control of convulsions.

Pentolinium (Ansolysin)	Tablets: 20 mg Vials: 10 mg/ml	1.0-1.5 mg/kg/day PO divided q6-8h 0.05-0.25 mg/kg/day SC or IM divided q6-8h Increase by 50% increment to desired effect or toxicity.	May cause hypotension, constipation, or atropine- like symptoms.
phenazopyridine (Pyridium)	Tablets: 100 mg	12 mg/kg/day PO divided q8h	Use caution in presence of G6PD deficiency, GI problems or renal insufficiency. May cause Methemoglobinemia.
Phenobarbital (Luminal)	Tablets: 15, 30, 65 + 100 mg Elixir: 20 mg/5 ml Spansule: 60 + 100 mg Vials: 65 mg/ml	Sedation: 2-3 mg/kg/dose PO, IM, or PR; repeat PRN q8h Status Epilepticus: 10-15 mg total/kg IM or prefer- ably slowly IV with caution. Give 1/2 above dose stat then 1/4 dose q5 min. x 2 or until seizure stops. Chronic Anticonvulsant: 4-6 mg/kg/day PO divided q12h average starting dose.	IV administration may cause respiratory arrest or hypo- tension. Contraindicated in hepatic or renal disease and porphyria.

Phentolamine (Regitine)	Vials: 5 mg/ml	Pheochromocytoma Test: 0.1 mg/kg IV single dose Therapeutic: 5 mg/kg/day PO divided q4-6h.	May cause hypotension, arrhythmias, and GI dis- turbances.
Phenylephrine (Neo-Synephrine)	Vials: 10 mg/ml (1% solution) Nasal Solution: 0.25, 0.5 + 1.0% Ophthalmic Solution: 10%	0.1 mg/kg/dose SC or IM q1-2h PRN 1.0 mg/kg/day PO divide q4h IV Infusion: 10 mg/100 ml saline - adjust dosage rate to desired effect.	Use with caution in presence of hypertension, arrhythmias, hyperthyroidism, or hyper- glycemia.
Pilocarpine Hydrochloride (Pilocar)	Ophthalmic solution: 1, 2, 3, 4, 6 + 8%	1 or 2 drops O.U. PRN	
Piperazine (Antepar)	Tablets: 500 mg Syrup: 500 mg/ml	Enterobiasis + Oxyuriasis: 40 mg/kg/day PO single daily dose x 7 days Ascariasis: 70 mg/kg/day PO single daily dose x 2 days.	Contraindicated in epilepsy. Large doses may cause vomiting, urticaria, muscle weakness, blurred vision.

Polymyxin B (Aerosporin)	Vials: 50 mg (1 mg = 10,000 units) Otic Soln: 1 mg/ml	Enteric: 10-20 mg/kg/day PO divided q6h Systemic: Prematures & Newborns: 2.5-4.0 mg/kg/day divided q6h IM or q12h IV. Older Children: 2.5-3.0 mg/kg/day divided q4-6h IM or 1.5-2.5 mg/kg/day divided q12h IV. (Max. dose = 200 mg/day) Intrathecal or Intra- ventricular: <u><2 yrs:</u> 1-2 mg/day as single daily dose x 3-4 doses then qod. ≥ 2 yrs: 2.5-5.0 mg/day as single daily dose x 3-4 days then qod.	IV Route: Give by slow infusion over 1-2 hours IM Route: Difficult in older children because of severe pain. Pervasive renal and neurotoxicity.
Potassium Iodide (SSKI)	Tablets: 300 mg Solution: 100%	Expectorant: 2-4 drops in orange juice PO q8h Thyrototoxicosis: 0.9 ml or 900 mg KI/day PO divided q8h	Contraindicated in tuber- culosis.

Potassium Supplements	Potassium Chloride: (1.0 gm salt = 13.3 mEqK) Tablets (enteric coated): 0.3 + 1.0 gm Oral Solution and Oral Syrup (wild cherry): 500 mg/5 ml (10%) Potassium Gluconate: (Kaon) (1.0 gm salt = 4.3 mEq K) Elixir: 1.56 gm/5 ml (6.66 mEq K/5 ml) Potassium Triplex: (Acetate-bicarbonate- citrate) Oral Solution: 500 mg of each salt/5 ml (15 mEq K/5 ml)	Dose based upon clinical requirements	May cause GI disturbances and ulceration. Avoid overdosage.
Primidone (Mysoline)	Tablets: 50 + 250 mg Susp: 250 mg/5 ml	Initial: < 8 yrs: 125 mg/day PO as single dose > 8 yrs: 250 mg/day PO as single dose Increase: Weekly increments of 125-250 mg (max. = 2 gm/day) to desired effect. Divided q12h PO.	May cause megaloblastic anemia, hallucinations and other emotional reactions, CNS disturbances, rashes, and GI symptoms. Do not discontinue abruptly.

Procainamide (Pronestyl)	Capsules: 250 mg Vials: 100 mg/ml (10 ml)	PO: 40-60 mg/kg/day divided q4-6h IM: 20-30 mg/kg/day divided q6h IV: 2 mg/kg/dose (max. dose = 100 mg) diluted and given by slow infusion over 5 minutes repeat q10-30 minutes PRN. (Max. total daily dose = 2-4 gm PO or IM or 1-2 gm IV)	Monitor BP and EKG with IV use. Widening of QRS by more than 0.02 seconds suggests toxicity (stop or skip dose).
Prochlorperazine (Compazine)	Tablets: 5 mg Syrup: 5 mg/5 ml Supp: 5 + 25 mg Spansule: 10 + 15 mg Ampules: 5 mg/ml	0.4 mg/kg/day PO or PR divided q6-8h 0.2 mg/kg/day IM divided q6-8h	Toxicity as for other phenothiazines. CNS reactions not uncommon (extrapyramidal).
Promethazine (Phenergan)	Tablets: 12.5 + 25 mg Ampules: 25 mg/ml	Antihistaminic: 0.1 mg/kg/dose q6h and 0.5 mg/kg/dose hs PO PRN Nausea and Vomiting: 0.25-0.5 mg/kg/dose IM or PR q4-6h PRN Sedative & Preoperative: 0.5-1.0 mg/kg/dose IM q6h PRN Motion Sickness: 0.5 mg/kg/dose PO q12h PRN	Toxicity similar to other phenothiazines. (See Chlorpromazine.)

Propanolol (Inderal)	Tablets: 10 + 40 mg Ampules: 1 mg/ml	Arrhythmias: 0.5-1.0 mg/kg/day PO divided q6-8h (max. daily dose = 60 mg). 0.01-0.15 mg/kg/dose IV slowly; may repeat q6-8h PRN (max. single dose = 10 mg). Tetralogy Spells: 0.15-0.25 mg/kg/dose IV slowly; may repeat in 15 min. x 1 (max. single dose = 10 mg)	Contraindicated in asthma and heart block. Use with caution in presence of obstructive lung disease, heart failure, renal or hepatic disease. May cause hypoglycemia.
Propantheline (Pro-Banthine)	Tablets: 15 mg Vials: 30 mg	1-2 mg/kg/day PO divided qid pc and hs	Contraindicated in glaucoma and cardiac disease.
Propoxyphene (Darvon)	Capsules: 32 + 65 mg	2-4 mg/kg/day PO divided q4-6h	
Propylthiouracil (PTU)	Tablets: 50 mg	Initial: 6-10 yrs.: 150-300 mg/ day PO > 10 yrs.: 300-400 mg/ day PO Maintenance: (when euthyroid) 75-200 mg/day PO divided q8-12h	May cause blood dyscrasias, fever, liver disease, and dermatitis. Monitor thyroid function. 100 mg PTU = 10 mg Tapazole.

Protamine	Ampules: 10 mg/ml	<u>Heparin Antidote:</u> 1 mg for every 1 mg heparin in previous 3-4 h by IV drip (max. dose = 50 mg/dose)	May cause coagulation problem in absence of heparin.
Pseudoephedrine (Sudafed)	Tablets: 60 mg Syrup: 30 mg/5 ml	4-5 mg/kg/day PO divided q6h	Use with caution in hypertension.
Pyridinium (Povan)	Tablets: 50 mg Susp: 50 mg/5 ml	5 mg/kg/dose PO as single dose; repeat dose in 2 weeks.	May cause GI symptoms. Colors stools red.
Quinacrine (Atabrine)	Tablets: 100 mg	<u>Giardiasis:</u> 8 mg/kg/day PO divided q8h x 5 days (max. dose = 300 mg/day) <u>Tapeworms:</u> 15 mg/kg/day PO divided into 2 doses 1 hour apart. Saline purge 2 hours after last dose. (Max. dose = 800 mg)	May cause GI disturbances.

Quinidine	Gluconate: Tablets: 330 mg Vials: 80 mg/ml Sulfate: Tablets: 200 mg Extended Release Tablets: 300 mg	Test Dose: 2 mg/kg/dose PO, IM (or IV for extreme emergencies only) Therapeutic Dose: <u>Sulfate:</u> Initial: 3-6 mg/kg/dose PO repeated q2-3h x 5 Maintenance: increase to max. of 12 mg/kg/dose q2-4h <u>Gluconate:</u> 2-10 mg/kg/ dose IM or IV repeat q3-6h (reserve IV for extreme emergencies)	Toxicity indicated by increase of QRS interval by 0.02 seconds or more (skip dose or stop drug). May cause GI symptoms, hypotension, tinnitus, blood dyscrasias.
Reserpine (Serpasil)	Tablets: 100 + 250 micrograms Ampules: 2.5 mg/ml Vials: 2.5 mg/ml	General Use & Chronic <u>Hypertension:</u> 0.02 mg/ kg/day PO divided q12h <u>Acute Hypertension:</u> 0.07 mg/kg/dose IM repeat q8-24 hours PRN (use with hydralazine if necessary).	May cause CNS and respiratory depression in newborns of treated mothers. Discontinue 2 or more weeks before elective surgery.
Rifampin (Rimactane)	Capsules: 300 mg Syrup: 20 mg/ml	Antituberculosis: 10-20 mg/kg/day PO as single dose (max. dose = 600 mg/d)	Use with caution in liver dysfunction. Not officially released yet for children.

Salicylazo- sulfapyridine (Azulfidine)	Tablets: 500 mg	Initial: 75-150 mg/kg/day PO divided q4-8h Maintenance: 40 mg/kg/day PO divided q6h	See Sulfisoxazole.
Scopolamine (Hyoscine)	Tablets: 400 + 600 micrograms Vials: 1 mg/ml	6 micrograms/kg/dose PO or SC	See Atropine.
Secobarbital (Seconal)	Capsules: 32, 50 + 100 mg Supp: 60 mg Vials: 50 mg/ml	Same as Amobarbital	See Amobarbital.
Sodium Polystyrene Sulfonate (Kayexalate)	Oral Powder: 450 gm Susp: 25%, in sorbitol solution (25%)	Practical Exchange Rate: 1 mEq potassium per 1 gm resin. Calculate dose according to desired exchange. PO or rectally q6h PRN	Use with caution in presence of renal failure. (Na+ exchanged for K+; may also cause hypocalcemia and hypomagnesemia.)
Spiro-nolactone (Aldactone)	Tablets: 25 mg	1.7-3.3 mg/kg/day PO divided q6-8h	Contraindicated in acute renal insufficiency. May potentiate ganglionic blocking agents and other antihypertensives.

Streptomycin	Vials: 400 mg/ml	Premature & Full Term <u>Newborn:</u> 20-30 mg/kg/day IM divided q12h up to 10 days <u>Children:</u> 40 mg/kg/day IM divided q12h up to 10 days <u>Tuberculosis:</u> 20-50 mg/kg/ day IM single dose (use higher dose for TB meningitis)	Reduce dose in presence of renal insufficiency. Follow auditory status. May cause CNS depression and other neurologic mani- festations.
Sulfadiazine	Tablets: 500 mg Susp: 500 mg/5 ml Ampules: 250 mg/ml	See Sulfisoxazole.	See Sulfisoxazole.
Sulfisoxazole (Gantrisin)	Tablets: 500 mg Susp: 500 mg/5 ml Ampules: 400 mg/ml	Initial: 75 mg/kg/day PO divided q4-6h; 50 mg/kg/ day IV divided q6h Maintenance: 150 mg/kg/day PO divided q4-6h; 100 mg/ kg/day IV divided q6h (max. dose = 6 gm/day) Rheumatic Fever Pro- phyllaxis: $\leq$ 30 kg: 500 mg/day PO single dose $>$ 30 kg: 1 gm/day PO single dose.	Contraindicated in infants under 2 months, near-term pregnant or nursing mothers. Use with caution in presence of renal or liver disease, or G6PD deficiency. Maintain adequate fluid intake.

Tedral	Tablets: theophylline 130 mg ephedrine 24 mg phenobarbital 8 mg (per tablet) Pediatric Susp: theophylline 65 mg ephedrine 12 mg phenobarbital 4 mg (per 5 ml)	<u>Pediatric Suspension:</u> 5 ml/30 kg/dose repeat q6h PRN	Dose determined by theophylline content.
Tetracycline (Achromycin)	Tablets: 50, 100 + 250 mg Capsules: 50, 100 + 250 mg Drops: 100 mg/ml Syrup: 25 mg/ml Susp: 50 mg/ml Vials: 100, 250, + 500 mg	<u>Older Infants & Children:</u> 25-50 mg/kg/day PO divided q6h 10-25 mg/kg/day IM divided q8-12h 10-15 mg/kg/day IV divided q12h Children >40 kg: 1-2 gm/day PO divided q6h 10-20 mg/kg/day IM or IV divided q12h (max. dose = 2 gm/day)	May cause increased intracranial pressure, tooth staining, decreased bone growth, and GI reactions. Outdated drug may cause nephropathy. Not recommended in newborns and infants.
Theophylline (Elixophylline)	Elixir: 27 mg/5 ml	10 mg/kg/day PO or PR divided q8-12h	Use with caution in cardiac, renal, hepatic, hyperthyroid, ulcer disease and glaucoma (see aminophylline).

Thiabendazole (Mintezol)	Susp: 500 mg/ml	25 mg/kg/dose PO bid PC. Threadworms, hookworms, and ascarids: 1-2 days Whipworms: 2-4 days Pinworms: 1 day, repeat in 1 week	Caution in hepatic disease. May cause GI symptoms and dizziness.
Thyroid (desiccated)	Tablets: 15, 30, 60, 130 + 180 mg	Initial: Infants: 15 mg/dose PO single daily dose Children: 30 mg/dose PO single daily dose Usual Maintenance: 60- 180 mg/day PO single daily dose. Increase by 15 mg/day at weekly intervals	Follow and titrate with serum T4 level.
Tolnaftate (Tinactin)	Cream: 1% Solution: 1% Powder: 1%	Apply cream or 1 or 2 gtts of solution topically bid for 2 to 6 weeks.	Persistent infection may require systemic therapy with griseofulvin.
Triiodothyronine (Cytomel)	Tablets: 5 + 25 micrograms	Calculate dosage as for desiccated thyroid according to following equivalencies: 65 mg (1 grain) USP desiccated thyroid = 25 micrograms triiodothyronine.	See Thyroid.

Trimethadone (Tridione)	Capsules: 300 mg	Initial Dose: < 2 years: 300 mg/day PO divided q12h. 2-6 yrs: 600 mg/day PO divided q6-12h. > 6 yrs: 900 mg/day PO divided q6-12h. Increase By: 150-300 mg increments to desired clinical effect or toxicity.	Contraindicated in severe hepatic or renal disease or blood dyscrasias. May cause lupus-like symptoms and nephrosis.
Trimethobenzamide (Tigan)	Capsules: 100 + 250 mg Supp: 200 mg Ampules: 100 mg/ml	15 mg/kg/day PO, PR, or IM divided q6-8h PRN	IM route not recommended for infants.
Tripelennamine (Pyribenzamine)	Tablets: 25 + 50 mg Long-acting tablets: 100 mg Elixir: 37.5 mg/5 ml	5 mg/kg/day PO divided q4-6h (max. dose = 300 mg/day)	
Vasopressin (Pitressin)	Ampules: 20 units/ml (aqueous) Ampules: 5 units/ml (tannate in oil) Nose drops: 50 units/ml (arginine vasopressin - Diapid)	Aqueous: 1-3 ml/day SC divided q8h Tannate in Oil: 0.2 ml/ dose IM q1-3day PRN; may increase to 1-2 ml/ dose Nose Drops: 1-2 gtts qhs each nostril q4-6h PRN.	

Vinblastine (Velban)	Vials: 10 mg	0.1-0.3 mg/kg/dose IV single weekly dose	See Vincristine.
Vincristine (Oncovin)	Vials: 1 + 5 mg	0.05 mg/kg/dose or 2 mg/M ² /dose IV as single weekly dose (max. single dose = 2 mg).	Follow hematologic status closely. Avoid extra- vasation. May cause blood dyscrasias, alopecia and neuromuscular symptoms.
Vitamin K (Aqua-Mephyton, Konakion)	Tablets: 5 mg Ampules: 1 mg/ml (aqueous) Ampules: 10 mg/ml (emulsion)	Hemorrhagic Disease of Newborn: Prophylaxis: 1 mg IM Treatment: 5-10 mg IM Hypoprothrombinemia: Infants: 2 mg/dose PO, IM, IV Children: 5-10 mg/dose PO, IM, IV	Follow protime. Use with caution in presence of severe hepatic disease. Large doses (> 25 mg) in newborn may cause hyper- bilirubinemia.

DIGITALIS AND ALLIED PREPARATIONS

PREPARATION	EFFECT			TOTAL EXCRETION	ORAL ABSORPTION	ROUTE OF ADMINISTRATION	DOSE	
	Earliest	Max.	Duration				Digitalizing	Daily Maintenance
OUABAIN (G. Strophanthin)	5 min.	30 min.	2 hrs.	24-48 hours	0	IV only	TDD = 10 microgm/kg 5 microgm/kg stat. 1 microgm/kg q 30 min. until response or total dose given	Redigitalize with long-acting drug 12 hrs. after onset of Rx
DIGIFOLINE	2 hrs.	4 hrs.	2 days	3 weeks		IV or IM	TDD = 25-35 mgm/kg 1/2 dose stat & 1/4 dose q6h x 2; or 1/6 dose stat and 1/6 dose q6h x 5	0.1 TDD
LANATOSIDE C Cedilanid	10-30 min.	2 hrs.	18-36 hrs.	3-6 days	10-20%	IV (best) or IM	TDD = 25 microgm/kg 1/2 dose stat; then 1/4 dose q2h x 2	Use long-acting drug for maintenance. Redigitalize with long-acting drug after 24h
DIGITOXIN Crystodigin Digitidin Digitaline Nativele Purodigin	30 min.	6 hrs.	2 days	2-3 weeks	100%	PO, IV, IM	TDD=25-35 microgm/kg 1/2 dose stat, and 1/4 dose q6h x 2; or 1/6 dose stat and 1/6 dose q6h x 5	0.1-0.2 TDD

DIGITALIS AND ALLIED PREPARATIONS (continued)

PREPARATION	EFFECT		TOTAL EXCRETION	ORAL ABSORPTION	ROUTE OF ADMINISTRATION	DOSE	
	Earliest	Max.				Digitalizing	Daily Maintenance
DIGOXIN (LANOXIN) 0.25 & 0.5 mg tablets 0.05 mg/ml elixir	5-30 min.	4-8 hrs.	48-72 hrs.	50-90*% consensus - 66%	PO, IM, IV	Premature & newborn: TDD=30-50 microgm/kg IM Under age 2 years: TDD=60-80 microgm/kg PO; 40-60 microgm/kg IM or IV Over age 2 years: TDD=40-60 microgm/kg PO; 20-40 microgm/kg IM or IV 1/2 dose stat; then 1/4 dose q6-8h x 2	0.25 TDD PO 0.20 TDD IM or IV divide q12h Usual adult maintenance 0.25-0.50/day

*Circ., 26:709, 1962.

INSULIN

Dose determined by clinical situation

Type of Insulin	Time and Route of Administration	Time of onset Hrs. after administration	Peak action Hrs. after administration	Duration of action: Hrs.	Time when glycosuria most apt to occur	Time when hypoglycemia most apt to occur
* Crystalline Zinc	IV (emergency) 15-20 min. before meals, SC	Rapid--within one hour	2 - 4	5 - 8	During night	10 a.m. to lunch
* Semi-Lente (Amorphous Zinc)	1/2-3/4 hr. before breakfast; deep SC, never IV	Rapid--within one hour	6 - 10	12 - 16	During night	Before lunch
Globin Zinc	1/2-1 hour before breakfast, SC	Intermediate--rapidity of onset increases with dose, within 2-4 hours	6 - 10	18 - 24 also increases with dose	Before breakfast & before lunch	3 p.m. to dinner
* Lente (combination of 30% semi-lente & 70% ultra-lente)	1 hour before breakfast; deep SC; never IV	Intermediate--within 2-4 hrs.	8 - 12	28 - 32	Before lunch	3 p.m. to dinner
NPH (Neutral-Protamine-Hagedorn) or Isophane	1 hour before breakfast; SC	Intermediate--within 2-4 hrs.	8 - 12	28 - 30	Before lunch	3 p.m. to dinner

* Contain no modifying protein, i.e., protamine or globin.

INSULIN (continued)

Dose determined by clinical situation

Type of Insulin	Time & Route of Administration	Time of onset Hrs. after administration	Peak action Hrs. after administration	Duration of action: Hours	Time when glycosuria most apt to occur	Time when hypoglycemia most apt to occur
Protamine Zinc (PZI)	1 hour before breakfast; SC	Slow-acting--within 4-6 hrs	16 - 24	24 - 36+	Before lunch and at bedtime	2 a.m. to breakfast
*Ultra-lente	1 hour before breakfast; deep SC, never IV	Very slow--8 hours	16 - 24	36+		During night, early morning

* Contain no modifying protein, i.e., protamine or globin.

ADRENAL GLUCOCORTICOIDS

HOW SUPPLIED:

<u>Cortisone Acetate:</u>	Tablets: 5 + 25 mg Vials: 25 + 50 mg/ml
<u>Hydrocortisone:</u>	Tablets: 5, 10 + 20 mg Susp: 2 mg/ml Vial: 5 mg/ml
Na succinate: (Solu-Cortef)	Vials: 100, 250 + 500 mg
Acetate:	Vials: 25 mg/ml
<u>Prednisone:</u>	Tablets: 1 + 5 mg
<u>Prednisolone:</u>	Tablets: 5 mg Vials: 25 + 50 mg
<u>Methylprednisolone:</u>	Tablets: 4 mg Extended Release Tablets: 4 mg
Na succinate: (Solu-Medrol)	Vials: 40, 125 + 1000 mg
Acetate: (Depo-Medrol)	Vials: 40 mg/ml
<u>Triamcinolone:</u>	Tablets: 1, 2 + 4 mg Vials: 10 + 40 mg/ml Topical Cream: 0.025, 0.1, 0.5% Topical Ointment: 0.01, 0.1% Lotion: 0.025%
<u>Dexamethasone:</u>	Tablets: 0.5 + 0.75 mg Oral Liquid: 0.5 mg/5 ml Vials: 4 mg/ml Cream: 0.1%

DOSE AND ROUTE:Cortisone Acetate:Physiologic Replacement:

25 mg/m²/day PO divided q8h
12 mg/m²/day IM single daily dose

Virilizing Adrenal Hyperplasia:

25 mg/m²/day PO divided q8h
37 mg/m²/dose IM every 3 days

ADRENAL GLUCOCORTICOIDS continued:

Prednisone:Physiologic Replacement and General Use:

20% of cortisone dose

Therapeutic:Leukemia and Lymphomas: 40-120 mg/m²/day
PO divided q8-12hNephrotic Syndrome: * 2 mg/kg/day PO
single or divided dosesRheumatic Carditis: 1.5-2.0 mg/kg/day PO
single or divided dosesTuberculosis: 1-2 mg/kg/day PO single or
divided dosesHydrocortisone sodium succinate:Gram negative shock:

Initial dose: 50 mg/kg IV

Subsequent dosage: 50-75 mg/kg/day IV
divided q6h

(Max. single dose = 500 mg)

Status Asthmaticus: 10 mg/kg/day IV
divided q6hREMARKS:

Equivalent Doses For Same Clinical Effects

DRUG	Glucocorticoid Anti-Inflammatory	Mineralo- corticoid
Cortisone acetate	100 mg	100 mg
Hydrocortisone	80 mg	80 mg
Prednisone	20 mg	100 mg
Prednisolone	20 mg	100 mg
Methylprednisolone	16 mg	no effect
Triamcinolone	16 mg	no effect
9 α fluorocortisol	5 mg	0.2 mg
Dexamethasone	2 mg	no effect
DOCA	no effect	2 mg

Duration of Action

Cortisone acetate:	6 hour PO and IV (1/2 life 60-90 min.); 3 days IM
Hydrocortisone Na succinate:	4-6 hours IV (1/2 life 60-90 min.)
Triamcinolone:	8-12 hours PO
Dexamethasone:	8-12 hours PO
Prednisone:	6-8 hours PO

*QOD dosage advisable after initial therapy to
minimize growth retardation.

ADRENAL MINERALOCORTICOIDS

HOW SUPPLIED:Desoxycorticosterone acetate (DOCA):Vials: 5 mg/ml - in oil
Pellets: 125 mg9 α -Fluorocortisol (Fludrocortisone):

Tablets: 0.1 mg

DOSE AND ROUTE:Desoxycorticosterone acetate:1-3 mg/day IM (in oil) single dose
250-375 mg/year SC (implants)9 α -Fluorocortisol:

0.05-0.15 mg/day PO

REMARKS:

Equivalent Na Retention:

1 mg DOCA = 0.1 mg 9 α -fluorocortisol.

GUIDE FOR PREOPERATIVE MEDICATION
Before General Anesthesia

AGE IN MONTHS	DRUGS USED
0- 6	Atropine only
6-12	Atropine and Pentobarbital
over 12	Atropine (or scopolamine) Pentobarbital Morphine (or meperidine)

DOSAGES

Atropine (or scopolamine):	
0.02 mg/kg	- min. dose 0.15 mg
	- max. dose 0.60 mg
Pentobarbital:	
3.0-4.0 mg/kg	- max. dose 120 mg
Morphine:	
0.05-0.10 mg/kg	- max. dose 10 mg
Meperidine:	
1.0-2.0 mg/kg	- max. dose 100 mg

Modified from J. J. Downes, Ped. Clin. N.A.,
16:601, 1969

INTRAVENOUS ANTI-ARRHYTHMIC DRUGS

DRUG	DOSE	INDICATIONS	CAUTIONS
Digitalis Preparations	See Page 152.	Supraventricular arrhythmias: 1) PAT or PNT unresponsive to vagal stimulation. 2) Atrial flutter - fibrillation.	Contraindicated in ventricular arrhythmias. May cause heart block and other arrhythmias. Monitor EKG.
Diphenylhydantoin (Dilantin)	1-3 mg/kg slow IV push, repeat PRN (max. total dose = 500 mg in 4 hrs.)	1) Ventricular arrhythmias, especially ventricular tachycardia. 2) Digitalis-induced arrhythmias, especially PAT with block.	Bradycardia. Monitor EKG.
Isoproterenol (Isuprel)	1-4 mg/liter D5W as continuous IV infusion. Rate: 0.5-4.0 micrograms/minute	Complete heart block or severe bradycardia.	Use care in presence of congestive failure or ventricular irritability. Monitor EKG.
Lidocaine (Xylocaine)	Slow IV Push: 2% solution: 0.5-1.0 mg/kg/dose repeat q5-10 minutes PRN. Continuous IV Drip: 20-50 micrograms/kg/minute (max. total dose = 5 mg/kg).	Ventricular arrhythmias, especially digitalis-induced.	May cause hypotension, seizures, and cardiac or respiratory arrest. Monitor BP and EKG.
Metaraminol (Aramine)	50 mg in 100 cc D5W IV drip (max. dose = 2 mg/kg)	PAT or PNT unresponsive to digitalis.	Titrate to desired effect. Pressor drug. Monitor blood pressure and EKG.

Phenylephrine hydrochloride (Neo-synephrine)	10 mg (1 ml of 1% solution) in 100 ml saline as continuous IV infusion. Titrate to desired effect.	PAT or PNT unresponsive to digitalis.	Pressor agent. May cause bradycardia and other arrhythmias. Monitor blood pressure and EKG.
Procainamide hydrochloride (Pronestyl)	2 mg/kg/dose in D5W IV slowly over 5 min. Repeat q10-30 min PRN. (max. dose = 100 mg)	Ventricular tachycardia and flutter. Supraventricular arrhythmias unresponsive to digitalis.	May produce ventricular arrhythmias and hypotension. Monitor blood pressure and EKG.
Propanolol (Inderal)	General Arrhythmias: 0.01-0.15 mg/kg/dose slow IV push, may repeat q6-8h PRN (max. single dose = 10 mg) Tetralogy Spells: 0.15-0.25 mg/kg/dose IV slowly, may repeat in 15 min x 1 (max. single dose = 10 mg)	Ventricular tachycardia, PVC's and digitalis-induced arrhythmias. Supraventricular tachycardia unresponsive to digitalis. Tetralogy spells.	May cause hypotension, hypoglycemia, and bronchospasm. Monitor BP and EKG.
Quinidine gluconate	2-10 mg/kg/dose IV repeat q3-6h PRN	Ventricular arrhythmias, atrial flutter or fibrillation, and to prevent PAT in Wolff-Parkinson-White Syndrome.	Use for atrial arrhythmias only in well-digitalized patient. May cause ventricular arrhythmias (increase in QRS by 0.02 or more) and hypotension. Monitor EKG and BP.

DOSAGES OF ANTIBIOTICS IN UREMIA

Modifications are based primarily on serum half-lives of the antibiotics in anuric patients.

A single dose of the antibiotic is given based on a q6h, q8h, or q12h schedule, but all subsequent doses are halved and given at intervals based on the following table. For example: if a child were to normally receive 10 mg/kg/day of Kanamycin as 5 mg/kg q12h, then he would get 5 mg/kg initially but the interval before the next dose of 2.5 mg/kg would be 36-48 hours (Clcr $\geq$ 10 ml/minute) or 72-96 hours (Clcr $<$ 10 ml/minute) later.

Extreme caution must be exercised and these dosage modifications are approximations only. Serum levels of antibiotics at appropriate intervals should be measured and dosage and/or interval adjusted according to serum levels and early signs of toxicity.

ANTIBIOTICS IN UREMIA

ANTIBIOTIC	SERUM HALF-LIFE (In Hours)		ALSO REMOVED BY	DOSE MODIFICATION	MODIFIED DOSE INTERVAL (in Hours) in AZOTEMIA	
	Normal	Oliguria			Clcr < 10	Clcr > 10
Cephalexin	0.5-0.8	3-18	Liver	Minor	24	12
Chloramphenicol	1.6-3.3	3-4	Liver	None	-	-
Chlortetracycline	5.6	7-11	Liver	Do Not Use	-	-
Colistin	2	48-72	?	Major	72-96	36-48
Erythromycin	1.4	5-6	Liver	None	-	-
Gentamycin	3	6-20	?	Major	40-56	12-36
Kanamycin	3	72-96	?	Major	72-96	36-48
Methicillin	0.5	4	Liver	None	-	-
Oxacillin	0.5	2	Liver	None	-	-
Penicillin G	0.5	7-10	Liver	Minor	8-10	4-5
Polymyxin B	6	48-72	?	Major	72-96	36-48
Streptomycin	2.5	52-100	?	Major	72-96	36-48
Tetracycline	8.5	57-108	Liver	Major	72-96	36-48

Modified from Kunin, C.M., Annals Internal Medicine 67:151, 1967, and individual package inserts.

DRUGS AND CHEMICALS TO BE AVOIDED BY PERSONS
WITH "REACTING" (PRIMAQUINE SENSITIVE) RED CELLS

Antimalarials

1. Primaquine
2. Pamaquine
3. Pentaquine
4. Plasmoquine

Sulfonamides

1. Sulfanilamide
2. Sulfapyridine
3. Sulfisoxazole (Gantrisin)
4. Salicylazosulfapyridine (Azulfidine)
5. Sulfamethoxypryridazine (Kynex, Midicel)
6. Sulfacetamide (Sulamyd)

Nitrofurans

1. Nitrofurantoin (Furadantin)
2. Furazolidone (Furoxone)
3. Furaltadone (Altafur)

Antipyretics and Analgesics

1. Acetylsalicylic Acid
2. Acetanilide
3. Acetophenetidin (Phenacetin)
4. Antipyrine
5. Aminopyrine (Pyramidon)
6. p-Aminosalicylic Acid

Others

1. Sulfoxone
2. Naphthalene
3. Methylene Blue
4. Phenylhydrazine
5. Acetylphenylhydrazine
6. Probenecid
7. Fava Bean

NOTE: Many other compounds have been tested, but are free of hemolytic activity. Penicillin, chloromycetin, the tetracyclines, and erythromycin, for example, will not cause hemolysis. Also, the incidence of allergic reactions in these individuals is not any greater than that observed in normals. Any drug, therefore, which is not included in the list known to cause hemolysis, may be given.

PART III

THERAPEUTIC DATA



F L U I D A N D

E L E C T R O L Y T E T H E R A P Y

A. GENERAL CONSIDERATIONS

1. Atomic Weights

Aluminum (Al)	26.97
Antimony (Sb)	121.76
Arsenic (As)	74.91
Barium (Ba)	137.36
Bismuth (Bi)	209.00
Bromine (Br)	79.92
Cadmium (Cd)	112.41
Calcium (Ca)	40.08
Carbon (C)	12.01
Chlorine (Cl)	35.46
Cobalt (Co)	58.94
Copper (Cu)	63.57
Fluorine (F)	19.00
Gold (Au)	197.20
Helium (He)	4.00
Hydrogen (H)	1.01
Iodine (I)	126.92
Iron (Fe)	55.85
Lead (Pb)	207.21
Magnesium (Mg)	24.32
Manganese (Mn)	54.93
Mercury (Hg)	200.61
Nickel (Ni)	58.69
Nitrogen (N)	14.01
Oxygen (O)	16.00
Phosphorus (P)	30.98
Porcelain	999.01
Potassium (K)	39.10
Radium (Ra)	226.05
Radon (Rn)	222.00
Silicon (Si)	28.06
Silver (Ag)	107.88
Sodium (Na)	23.00
Sulfur (S)	32.06
Thorium (Th)	232.12
Tin (Sn)	118.70
Uranium (U)	238.07
Zinc (Zn)	65.38

2. Ion Calculations

a. Moles:

Mole = molecular weight in grams
 Millimole = molecular weight in milligrams

$$\begin{array}{r}
 \text{Na } 23 \\
 \text{Cl } 35.5 \\
 \hline
 \text{NaCl } 58.5 \text{ gm} = 1 \text{ mole} \\
 \phantom{\text{NaCl }} 58.5 \text{ mg} = 1 \text{ mM}
 \end{array}$$

b. Equivalents:

Equivalent = atomic weight divided by
valence

mEq = equivalent weight in mg

μ Eq = equivalent weight in μ g

Na⁺ = 23/1

23 gm Na = 1 Eq

23 mg Na = 1 mEq

For single valence ions 1 mM = 1 mEq.

For divalent ions 1 mM = 2 mEq.

c. Osmolality:

Osmol = atomic weight divided by number
of particles exerting osmotic
pressure

1 mM Na⁺ = 1 mOsm

1 mM NaCl = 2 mOsm (Na⁺ + Cl⁻)

1 mM Na₂SO₄ = 3 mOsm (2Na⁺ + SO₄⁼)

Osmolality is the preferred term rather
than osmolarity and represents solute
concentration per unit solvent (water)
rather than solution (serum).

3. Conversion Factors

The following table gives factors for conversion of concentrations expressed in milliequivalents per liter to milligrams per 100 milliliters, and vice versa, for common ions that occur in physiologic solutions.

Element or Radical	mEq per Liter	Mg per 100 Ml	Mg per 100 Ml	mEq per Liter
Sodium	1	2.30	1	0.4348
Potassium	1	3.91	1	0.2558
Calcium	1	2.01	1	0.4988
Magnesium	1	1.22	1	0.8230
Chloride	1	3.55	1	0.2817
Bicarbonate (HCO ₃)	1	6.10	1	0.1639
Phosphorus (valence 1)	1	3.10	1	0.3226
Phosphorus (valence 1.8)	1	1.72	1	0.5814
Sulfur (valence 2)	1	1.60	1	0.6250

Example: To convert milliequivalents of magnesium per liter to milligrams per 100 milliliters, multiply by the factor 1.22.

To convert milligrams of potassium per 100 milliliters to milliequivalents per liter, multiply by the factor 0.2558.

B. CALCULATION OF MAINTENANCE REQUIREMENTS

1. Principle

Water and electrolyte requirements are based on caloric expenditure.

2. Calculation of Caloric Expenditure for Maintenance Therapy

a. Standard Basal Calories:

STANDARD BASAL CALORIES

Weight Kg	Calories/24 Hours Male and Female	
3.....	140	
5.....	270	
7.....	400	
9.....	500	
11.....	600	
13.....	650	
15.....	710	
17.....	780	
19.....	830	
21.....	880	
25.....	1020	960
29.....	1120	1040
33.....	1210	1120
37.....	1300	1190
41.....	1350	1260
45.....	1410	1320
49.....	1470	1380
53.....	1530	1440
57.....	1590	1500
61.....	1640	1560

b. Increment for Temperature:

Add 12% of above for each degree centigrade (8% for each degree Fahrenheit) above rectal temperature of 37.8°C (100°F).

c. Increment for Activity:

Add 0-30% of above for bed activity; e.g., coma or thrashing about.

3. Average Water and Electrolyte Expenditures Per 100 Calories Metabolized Per 24 Hours

ROUTE	USUAL			RANGE		
	H ₂ O	Na	K	H ₂ O	Na	K
Lungs	15	0	0	10-60	0	0
Skin	40	0.1	0.2	20-100	0.1-3.0	0.2-1.5
Stool	5	0.1	0.2	0-50	0.1-4.0	0.2-3.0
Urine	65	3.0	2.0	0-400	0.2-30	0.4-30
TOTAL	125	3.2	2.4	30-610	0.4-37	0.8-34.5

a. In spite of 125 cc H₂O being lost for every 100 cal/24 hr, the usual H₂O requirement is 5-15 cc less (i.e., 110-120 cc) because of the production of endogenous H₂O through oxidation of CHO, fat and protein.

b. Abnormally high values in above tables may be considered to represent abnormal losses.

4. Average Water and Electrolyte Requirements for Different Clinical States per 100 Calories Per 24 Hours

Based on data in preceding table:

	ml H ₂ O	mEq Na	mEq K
*Average patient receiving			
<u>parenteral fluids</u>	110-120	2-4	2-3
Anuria	45	0	0
Acute CNS infections and			
inflammation	80-90	2-4	2-3
Chronic renal disease			
with fixed specific			
gravity	140	variable	variable
Diabetes insipidus	Up to 400	variable	variable
Hyperventilation	120-210	2-4	2-3
Heat Stress	120-240	variable	variable
High humidity			
environment	80-100	2-4	2-3
Paraoperative and post-			
operative patient	85	1-2	0

*Adequate maintenance solution:

Na and Cl: 30 mEq/L

K: 20 mEq/L

This is provided by:

5 or 10% invert sugar or glucose in H₂O.....800 ml

Isotonic saline.....200 ml

Potassium acetate concentrate (Cutter).....5 ml

OR

Dextrose 5% in 0.2% NaCl + 20 mEq/L K acetate.

C. DEFICIT THERAPY

1. Principles

- a. Initial step: Rapidly expand the extra-cellular volume in order to improve the circulation and renal function. Blood is used only for shock not responding to Ringer's lactate.
 - 1) Ringer's lactate 20 cc/kg/1st hour.
 - 2) Blood or plasma 10 cc/kg, if indicated.
- b. Replace intracellular deficits slowly over 8-12 hours. See table below for approximate magnitude of deficits.
- c. Maintenance therapy for usual losses.
- d. Replace continued abnormal losses.

2. Calculation of Deficits

PROBABLE DEFICITS OF WATER AND ELECTROLYTES IN INFANTS WITH SEVERE DEHYDRATION (10 - 12 PER CENT)

Condition	H ₂ O ml	Na mEq Per Kg of Body Weight	K* mEq	Cl mEq
Fasting and thirsting	100-120	5-7	1-2	4-6
Diarrhea				
Isotonic	100-120	8-10	8-10	8-10
Hypertonic	100-120	2-4	0-4	-2 - 6**
Hypotonic	100-120	10-12	8-10	10-12
Pyloric stenosis	100-120	8-10	10-12	10-12
Diabetic acidosis	100-120	8-10	5-7	6-8

*Converted for breakdown of tissue cells: -1 gm N = 3 mEq of K.

**Negative balance of chloride indicates excess at beginning of therapy.

3. Correction of Persistent Symptomatic Disturbances of Electrolyte Concentration

Formula: $(CD - CA) \times fd \times Wt \text{ in Kg} = \text{mEq required}$

CD = concentration desired (mEq/L)

CA = concentration present (mEq/L)

fd = apparent distribution factor as fraction of body weight

Electrolyte	Apparent Distribution Factor (fd)
Bicarbonate	0.4-0.5
Chloride	0.2-0.3
Sodium	0.6-0.7

D. REPLACEMENT OF CONCURRENT LOSSES IN ADDITION TO MAINTENANCE REQUIREMENTS

COMPOSITION OF EXTERNAL ABNORMAL LOSSES*				
Fluid	Na	K mEq/L	Cl	Protein Gm%
Gastric	20-80	5-20	100-150	----
Pancreatic	120-140	5-15	90-120	----
Small intestine	100-140	5-15	90-130	----
Bile	120-140	5-15	80-120	----
Ileostomy	45-135	3-15	20-115	----
Diarrheal	10-90	10-80	10-110	----
Sweat				
Normal	10-30	3-10	10-35	----
Cystic fibrosis	50-130	5-25	50-110	----
Burns	140	5	110	3-5

*These losses should be determined q6h-q8h.

COMPOSITION OF FREQUENTLY USED ORAL SOLUTIONS

Liquid	CHO gm/100 ml.	Prot.* gm/100 ml.	Calories Na per L.	K	Cl	HCO ₃ **	Ca	P†
Milk (whole).....	4.9	3.5	670	22	36	30	60	54
Milk (skim).....	5.5	3.5	375	23	43	-	61.8	56.9
Coca-Cola.....	10.9	-	435	0.4	13	13.4	-	-
Pepsi-Cola.....	12.0	-	480	6.5	0.8	7.3	-	-
Quaker ale.....	10.15	-	411	7.0	0.5	0	5	-
Orange juice.....	9.0	-	360	3.5	0.1	3.6	2.7	-
Orange juice (sweetened).....	14.0	-	540	0.2	49	50	-	-
Grape juice.....	18.0	-	670	0.4	31	32	-	-
Tomato juice (canned and salted).....	4.3	-	210	100	59	150	3	9
Apple juice.....	14.3	-	522	1.9	26.6	-	-	-
Lactogen.....	7.0	-	280	25	25	30	4	5
HLH mixture.....	5.0	-	200	30	20	30	0	0
Pedialyte.....	-	-	-	30	20	30	4	0
H ₂ O (Baltimore City).....	-	-	-	3	0.5	4	-	-

* Protein or amino acid equivalent

** Actual or potential bicarbonate, such as lactate, citrate, or acetate

† Calculated according to valence of 1.8

x Approximate values: actual values may vary somewhat in various localities depending on electrolyte composition of water supply used to reconstitute solution

* Protein or amino acid equivalent

** Actual or potential bicarbonate, such as lactate, citrate, or acetate

† Calculated according to valence of 1.8

x Approximate values: actual values may vary somewhat in various localities depending on electrolyte composition of water supply used to reconstitute solution

COMPOSITION OF FREQUENTLY USED PARENTERAL FLUIDS

Liquid	CHO gm/100 ml.	Prot.* gm/100 ml.	Calories Na per L.	K x		Cl mEq/L	HCO ₃ **	Ca	P†
D5W.....	5	-	200	-	-	-	-	-	-
D10W.....	10	-	400	-	-	-	-	-	-
Isotonic (normal) saline.....	-	-	154	-	-	154	-	-	-
1/2 Isotonic saline.....	-	-	77	-	-	77	-	-	-
D5 1/5 isotonic saline.....	5	-	200	-	-	31	-	-	-
5% saline.....	-	-	850	-	-	850	-	-	-
M/6 sodium lactate.....	-	-	167	-	-	167	-	-	-
3.75% sodium bicarbonate.....	-	-	446	-	-	446	-	-	-
Ringer's.....	0-10	-	0-400	4	-	155.5	-	4.5	-
Pinger's lactate.....	0-10	-	0-44	4	-	109	28	3	-
Darrow's KNL.....	-	-	122	35	-	104	53	-	-
Amigen 5%.....	5-10	5	345-515	15	-	22	-	5	30
Casein Hydrol 5%.....	-	5	39	18	-	-	-	-	-
Dextran 6%.....	0-5	-	0-200	-	-	-	-	-	-
Plasma (ACD).....	-	5	146	5	-	75	60	-	3

* Protein or amino acid equivalent

** Actual or potential bicarbonate, such as lactate, citrate, or acetate

† Calculated according to valence of 1.8

x Approximate values; actual values may vary somewhat in various localities depending on electrolyte composition of water supply used to reconstitute solution.

P O I S O N I N G

A. SUBSTANCES ABSORBED BY ACTIVATED CHARCOAL

Activated charcoal has been shown to be an effective complexing agent for many drugs and household poisons. The exact dose is as yet unknown but present data suggests that about 1 gm/kg is an effective dose. It is given, either PO or by nasogastric tube, as a suspension of fine powder in enough water to produce a slurry.

Inorganic Substances

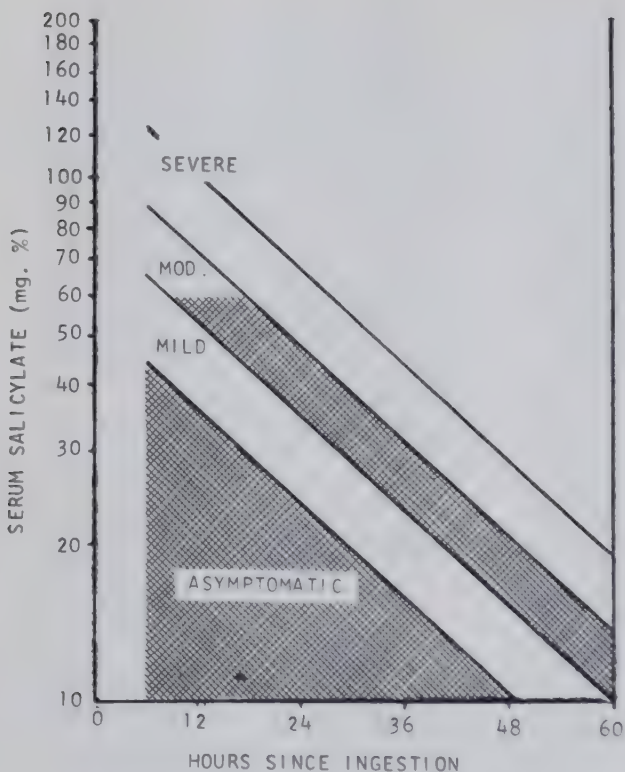
As	P
Ag	Pb
HgCl ₂	Sb
I	Sn
KMnO ₄	Ti

Organic Substances

Aconite	Metanamic Acid
Alcohol	Methylene Blue
Antipyrene	Morphine
Atropine	Muscarine
Barbiturates	Nicotine
Cantharides	Opium
Camphor	Oxalates
Chloroquine	Parathione
Chlorpheniramine	Penicillin
Chlorpromazine	Phenolphthalein
Cocaine	Phenol
Delphinium	Propoxyphene
Digitalis	Quinine
Elaterin	Salicylates
Ethchlorvynol	Stramonium
Glutethimide	Strychnine
Hemlock	Sulfonamides
Ipecac	Veratrum
Kerosene	

Adapted from J. Ped. 63:707, 1963 and from
Ped. Clin. N.A. 17, No. 3:537, 1970.

B. SALICYLATE POISONING



Nomogram relating serum salicylate concentration and expected severity of intoxication at varying intervals following the ingestion of a single dose of salicylate. (Ped., 26:800, 1963.)

B. SALICYLATE POISONING (Continued)

The patient's stomach should be emptied by lavage, or he should be made to vomit with ipecac.

1. Tests for Salicylate

- a. Screening Test for Serum Salicylate:
Serum from a hematocrit tube is placed on a Phenistix. A brownish color (about 25-50 mgm%) to purple color (about 150 mgm%) indicates the presence of salicylate in the serum. The diagnosis and/or therapy of salicylate poisoning should not be based on this screening test alone.
- b. Quantitative Serum Salicylate: In colorimeter tube labeled A, add 0.5 ml serum, 2.0 ml distilled water and 2.5 ml of $\text{Fe}(\text{NO}_3)_3$ reagent. In tube B, add 0.5 ml serum, 2.0 ml distilled water and 2.5 ml 0.07 N HNO_3 . After mixing, the blank and unknown are read at 540 m μ . The value of salicylate concentration is then obtained from an appropriate graph. Acetone bodies react also.
- c. Presumptive Urine Test: 3 ml of urine and 3 ml of 10% ferric chloride are mixed. A burgundy red color develops. Diacetic acid also gives a positive test. Diacetic acid can be removed by heating urine prior to adding the ferric chloride. A positive reaction after heating the urine indicates the presence of salicylates.

2. Treatment

- a. Early Therapy:
 - 1) Fluid: 160-180 ml/100 calories (5-10% carbohydrate) plus maintenance and replacement.
Electrolytes: Na 6-8 mEq/100 calories
K 3-4 mEq/100 calories
 - 2) Alkalinization of urine:
Bicarbonate: 2 mEq/kg given over 1 hour. Urine kept alkaline with additional sodium and potassium bicarbonate 2 mEq/kg of each over next 10 hours.

NOTE: Follow urine pH and if not 7 or above, more bicarbonate may need to be given.

NOTE: Na given as bicarbonate should be calculated as part of 6-8 meq/100 calories of Na given above.

- 3) Vitamin K: IM

b. Method of Finberg - Using Diamox:

- 1) IV M/18 Na lactate or NaHCO_3 in D5W or D10W - intake 150-200 ml/kg/24 hours. Adjust IV to achieve diuresis of 0.5 ml/min. Add maintenance.
- 2) Diamox - 5 mg/kg immediately after IV started.
- 3) After diuresis established add KCl 1 mEq/100 ml to IV solution.
- 4) Repeat Diamox for 2 additional doses in 1st 24 hours.
- 5) Periodically check urine and blood studies.

NOTE: In event of abnormal electrolyte pattern at onset of therapy, adjust Na and/or K accordingly.

C. POTASSIUM INTOXICATION

1. Treatment

- a. Sodium bicarbonate 2 mEq/kg in 1 hour as M/2 NaHCO_3 .
- b. Exchange resin enema (see Kayexalate - Drug Doses).
- c. IF NEEDED: Insulin 0.2 units/kg with glucose 200-400 mg/kg.

D. IRON INTOXICATION

1. Treatment

- a. Gastric lavage with sodium bicarbonate. May give 5-8 gm Desferal by stomach tube.
- b. Parenteral Desferal:
 - 1) Patients not in shock: IM Route:
1 gm initially IM followed by 500 mg q4h x 2 doses IM followed by 500 mg q 4-12 h IM.
Total Dose: ≤ 6 gm/24 hours.
 - 2) Patients in shock: IV Route:
Same doses as above but when giving Desferal IV the rate of infusion should not exceed 15 mg/kg/hr.
- c. IV fluids and/or transfusions should be given as necessary. Parenteral Desferal is excreted almost exclusively in the urine so that it is necessary to correct shock early.
- d. Significant iron ingestion is usually associated with a "Vin Rose" color of the urine due to the excretion of the Desferal - iron complex.

E. LEAD INTOXICATION - NO ENCEPHALOPATHY.

1. Diagnosis

Establish presumptive diagnosis using urine coproporphyrin test, flat plate of abdomen, long bone x-rays and CBC. Avoid lumbar puncture if possible.

2. Treatment

- a. Correct dehydration and/or electrolyte disturbances.
- b. After good urine output obtained give the following:

<u>Blood Lead Level</u>	<u>Treatment</u>
< 80 microgram %	EDTA 25 mg/kg BID x 5 days
80-100 microgram %	EDTA 8 mg/kg/ dose q4h x 3 days BAL 3 mg/kg/ dose q4h x 3 days
> 100 micrograms %	BAL 4 mg/kg x 1 dose followed by BAL 4 mg/kg and EDTA 12.5 mg/kg each q4h for 5-7 days.

F. LEAD INTOXICATION - WITH ENCEPHALOPATHY

1. Treatment

- a. Avoid lumbar puncture if possible.
- b. Establish urine flow cautiously.
- c. Then give maintenance IV fluids at 80-90 cc/100 calories/24 hours (acute CNS inflammation).
- d. Control seizures.
- e. Then give BAL + EDTA as above.

G. DIGITALIS INTOXICATION

1. Treatment

- a. Discontinue drug.
- b. Mild cases, KCl given by mouth in dose of 2-10 gm will suffice.
- c. Usual severe case: KCl by IV, given at rate of 1/2 mEq KCl/kg/hour with caution. The patient should be monitored by EKG.
- d. Stop KCl when signs of toxicity disappear or peaking of T waves becomes evident.
- e. Serious ventricular arrhythmias, use xylocaine (See Drug Doses).

B U R N S

A. MANAGEMENT OF BURNS

1. Initial Procedure: Perform a complete physical examination expeditiously and weigh the patient. Estimate the percentage of total body burn and record it on the burn chart. The "Rule of Nines" is not accurate for infants under 2 years of age and should be modified as shown on the following page. Consider 2nd and 3rd degree burns equally.

2. Amount and Composition of Intravenous Fluids

a. Replacement of loss from burn wounds:
Evans formula may be used to estimate 24 hour fluid replacements:

$\text{Kg} \times \% \text{ burn} \times 1.0 \text{ ml} = \text{colloid}$

$\text{Kg} \times \% \text{ burn} \times 1.0 \text{ ml} = \text{isotonic electrolyte solution}$

Plasmanate or Albumisol are used as Colloid. Ringer's Lactate or normal saline are used as isotonic electrolyte solution.

b. Maintenance Therapy: A standard maintenance fluid regimen should be used.

c. Replacement of nasogastric fluid loss:
Use normal saline or half normal saline. Potassium may be required.

3. Rate of Replacement

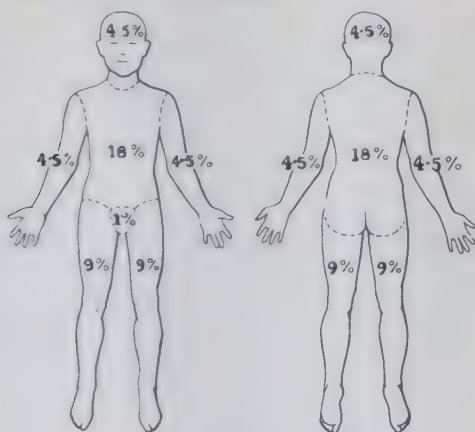
Calculate from time of burning. Half of replacement volume is given in the first eight hours; half in the next 16 hours. Serial monitoring is the key to careful replacement. Pulse rate, central venous pressure, hematocrit, total serum solids, serum electrolytes and urinary output are necessary guidelines. With extensive burns, bladder catheterization may be necessary.

4. General Comments

- a. Give tetanus toxoid.
- b. The use of systemic antibiotics should be at the discretion of the physician. Obtain throat and urine culture on admission.
- c. The current trend for care of the burn wound is "open technique" using

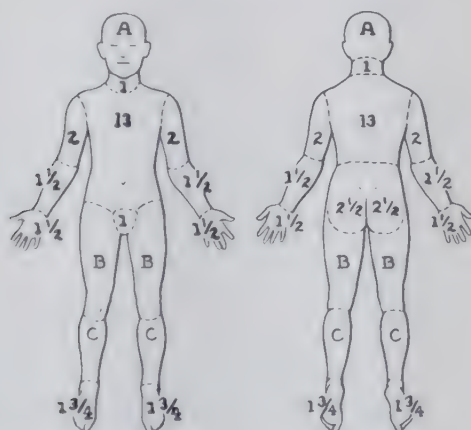
B U R N S

Estimate per cent of body surface involved using the following "Rule of Nines."



The Rule of Nines

These may have to be modified according to the patient's age in the following manner.



Relative percentage of areas affected by growth (After Lund and Browder.)

Age in years:	0	1	5	10	15	Adult
A=1/2 of head	9-1/2	8-1/2	6-1/2	5-1/2	4-1/2	3-1/2
B=1/2 of thigh	2-3/4	3-1/4	4	4-1/4	4-1/2	4-3/4
C=1/2 of 1 leg	2-1/2	2-1/2	2-3/4	3	3-1/4	3-1/2

Sulfamylon application. It should be remembered that metabolic acidosis might well be associated with Sulfamylon therapy in the more extensive burns.

- d. Physical therapy to maintain range of motion and thereby prevent contractures should be undertaken in the early stages of burn care. Hand burns are best treated closed with the hand in position of function.
- e. Culture "wet" burn areas qod.

B. PROTOCOL FOR LYE BURNS

Any pediatric patient with a history of lye ingestion should be admitted to the hospital. Burns of the oral pharynx and esophagus can present a serious problem that requires the cooperation and management of several services. In order to expedite their disposition and care, the following procedure is suggested:

1. For Acute Burns (48 hours) in Children
 - a. Identify the agent.
 - b. Make the child NPO.
 - c. Start an IV.
 - d. Type and cross match severely burned children.
 - e. Obtain CBC, urinalysis and chest film.
 - f. Notify ENT and Pediatric Surgery services.
 - g. Perform ESOPHAGOSCOPY within 12 hours of burn.
 - h. Perform esophageal cinefluoroscopy within 48 hours if possible.
2. If No Esophageal Burn:
 - a. Child should be observed in the hospital for 24-48 hours.
 - b. Care for the mouth burn.
 - c. Upon discharge, the patient should be followed by the ENT Clinic.
3. If Esophagus is Burned:
 - a. Steroid therapy (must be within 48 hours). Dose: 2 mg/kg/day of prednisone or its equivalent.
 - b. Antibiotics: Ampicillin x 10 days.
 - c. IV fluids until patient can handle secretions which is usually within 48 hours. Thereafter, a clear liquid diet and advance to soft diet as tolerated.
 - d. Further management, at this point, can be determined in consultation with the ENT and Pediatric Surgical Services.

RESPIRATORY CARE AND PULMONARY FUNCTION

GUIDE TO RESPIRATORY CARE

1. The patient should be turned side to side and side to back at least q2h. If the patient is mechanically ventilated, disconnect from ventilator for turning, then reconnect.
2. Suction should be performed PRN or at least q1h.
3. Saline instillation is best accomplished via a sterile suction catheter by injecting past the tip of the intratracheal airway as the operator brings the catheter up.

Normal sterile saline without a bacteriostatic additive is used for intratracheal instillation. Approximate amounts used:

Premature - Newborn	0.5 c.c.
Up to 1 year	1.0 c.c.
1 - 3 years	2.0 c.c.
3 - 5 years	2.5 c.c.
5 - 10 years	3.0 c.c.
10 years and older	3.5 to 4.0 c.c.

4. Hyperventilation with an "ambubag" connected to a source of O₂ is indispensable before and after saline instillations and suctioning. Breath sounds are to be checked bilaterally before and after suction.
5. Chest physiotherapy should be performed about every four to six hours. This should include:

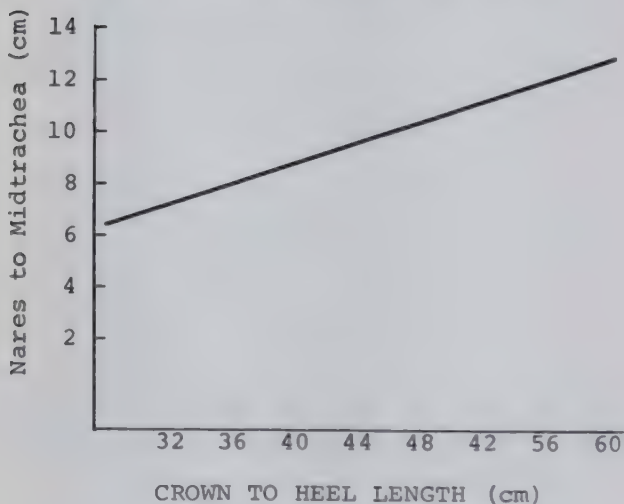
Percussion to all lobes or to specifically involved lobe(s). This is usually followed by:

Vibration, although difficult to accomplish with the hands, can be done with mechanical vibrators if available.

Thoracic "squeezing" is performed in combination with vibration. The goal is to maximally decrease the residual volume after a deep breath (usually a manual inflation with an "ambubag" produces an excellent deep breath). By compressing the sides of the thorax, a forceful expiration is obtained. Secretions may be expressed into larger airways, then suctioned.

6. Tracheal aspirates should be sent for culture q.o.d.
7. The inspired O_2 concentration (FI_{O_2}) should be checked at least q2h.
8. Ventilator settings should be stated in the Dr.'s orders. The desired O_2 concentration should be determined according to the blood gases. Any change in settings should be followed by blood gas analysis.

ESTIMATION OF NASOTRACHEAL TUBE LENGTH



Ref: Peds: 41:823, 1967.

ESTIMATION OF ENDOTRACHEAL TUBE SIZE

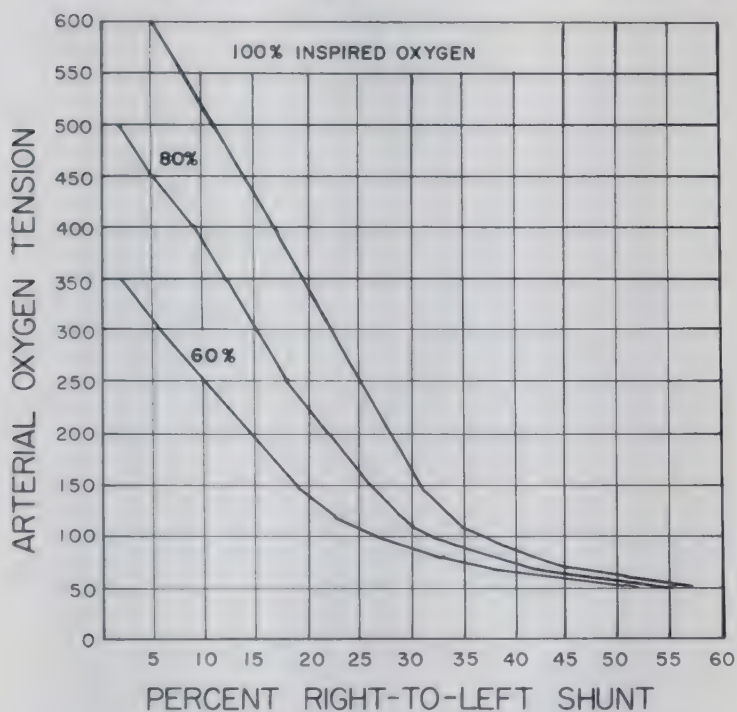
Approximate Age	French Equivalent	Metric Inside Diameter
Premie and Small Newborn	11-12 Fr.	2.5 mm
Large Newborn up 3 months	13 15	3.0 3.5
Up to 18 months	17 19	4.0 4.5
18 months to 3 years	20-21 22-23	5.0 5.5
3 to 5 years	24-26	6.0
5 to 7 years	26-27	6.5
8 to 10 years	29-30	7.0
11 - 12 years	32-33	7.5
12 years and older	34-35	9.0

BLOOD MEASUREMENTS IN
VARIOUS ACID-BASE DISTURBANCES*

	pH	PaCO ₂	HCO ₃ ⁻ (mEq/L)	CO ₂ Content (mEq/L)
NORMAL VALUES	7.35-7.45	35-45	24-26	25-28
Metabolic Acidosis	↓	↓	↓	↓
Acute Respiratory Acidosis	↓	↑	↔	slight ↑
Compensated Respiratory Acidosis	↔ or slight ↓	↑	↑	↑
Metabolic Alkalosis	↑	slight ↑	↑	↑
Acute Respiratory Alkalosis	↑	↓	↔	slight ↓
Compensated Respiratory Alkalosis	↔ or slight ↑	↓	↓	↓

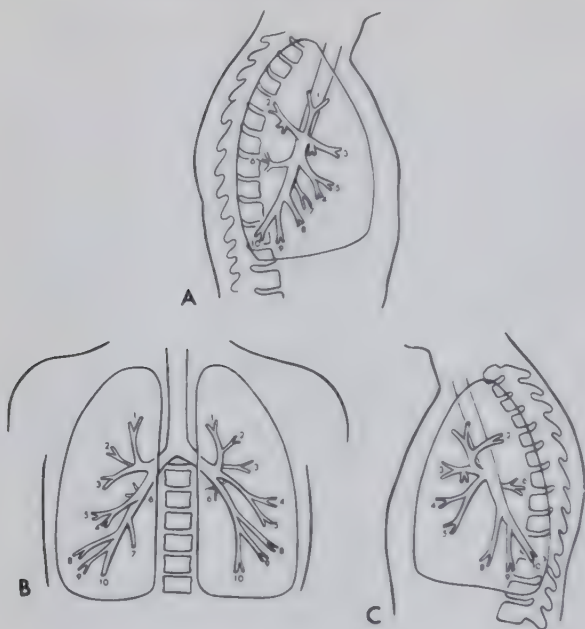
*Values obtained by arterialized capillary blood or direct arterial puncture.

SHUNT AT DIFFERENT INSPIRED OXYGEN MIXTURES



Calculations are based on an assumed hemoglobin of 16 gm%, an arteriovenous difference of 4 volumes per cent, a respiratory quotient of 0.8 and an arterial PCO_2 of 40 mmHg.

BRONCHOPULMONARY SEGMENTS



The nomenclature of bronchopulmonary anatomy, adapted from report by the Thoracic Society in 1950. (Adapted from Negus.)

RIGHT LUNG

Upper lobe

1. Apical
2. Posterior
3. Anterior

Middle lobe

4. Lateral
5. Medial

Lower lobe

6. Apical
7. Cardiac (medial basal)
8. Anterior
9. Lateral
10. Posterior

LEFT LUNG

Upper lobe

1. }
2. } Apicoposterior
3. Anterior

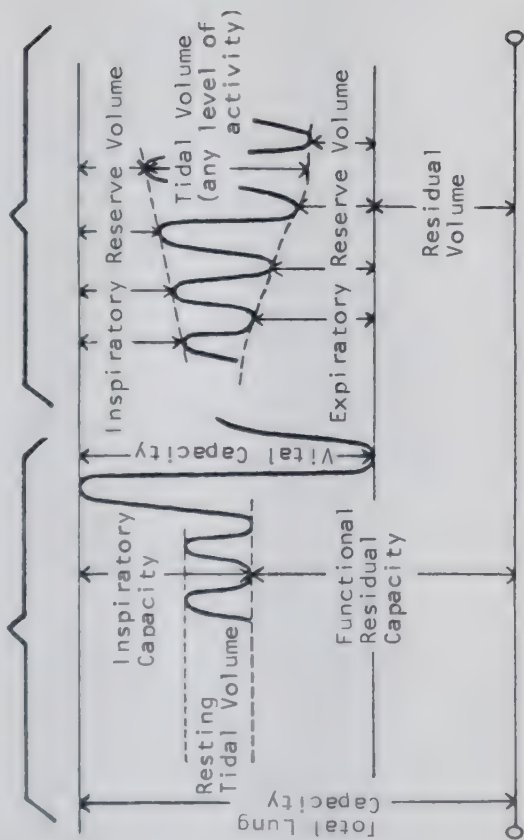
4. }
5. } Lingula

Lower lobe

6. Apical
 7. Absent
 8. Anterior
 9. Lateral
 10. Posterior
- } Basal

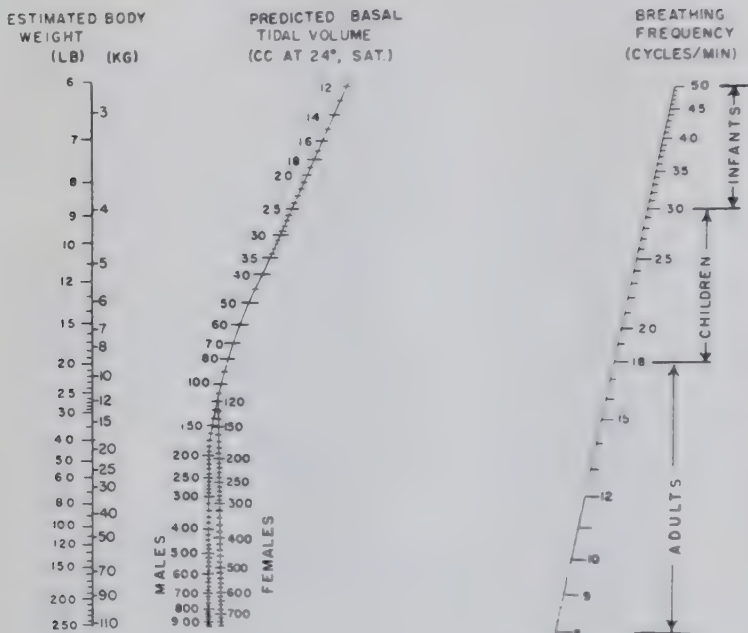
LUNG VOLUMES

Special Divisions for Pulmonary Function Tests Primary Subdivisions of Lung Volume



Subdivisions of Lung Volumes. Fed. Proc. 9:602, 1950

PREDICTED BASAL TIDAL VOLUME



CORRECTIONS TO BE APPLIED TO PREDICTED BASAL TIDAL VOLUME

- When measurements are based on English system (lb; °F.):
 - Daily activity (i.e. patients not in coma): add 10%
 - Fever: add 5% for each °F. above 99°F. (rectal)
 - Altitude: add 5% for each 2,000 feet above sea level.
 - Tracheotomy (or endotracheal tube): subtract a volume equal to one-half body weight in lbs.
- When measurements are based on Metric system:
 - Daily activity: add 10%
 - Fever: add 9% for each 1°C. above 37°C. (rectal)
 - Altitude: add 8% for each 1,000 M above sea level.
 - Tracheotomy (or endotracheal tube): subtract a volume equal to body weight (Kg.)

I N F E C T I O U S D I S E A S E S

RECOMMENDED SCHEDULE FOR ACTIVE
IMMUNIZATION OF INFANTS AND CHILDREN
Modified from the
American Academy of Pediatrics 1970

AGE	PREPARATION
2 months	DPT* Trivalent OPV#
4 months	DPT Trivalent OPV
6 months	DPT Trivalent OPV
12 months	Tuberculin Test Measles Vaccine
18 months	DPT Trivalent OPV
2-10 years	Rubella Tuberculin Test every 1-2 years
3 years	DPT
5 years	DT+ Trivalent OPV
12-14 years	DT Mumps Tuberculin Test
16 years	Tuberculin Test

After 16 years of age tetanus toxoid booster doses
should be repeated every 10 years.

*Diphtheria-Pertussis-Tetanus Toxoid

#Oral Polio Vaccine

+Diphtheria-Tetanus Toxoid

A. ACTIVE IMMUNIZATION

1. Diphtheria, Pertussis, and Tetanus (DPT)

Precipitated or absorbed triple vaccine: usual dose 0.5 ml. Start course between 6 and 8 weeks of age, giving injections 1 to 3 months apart, although up to 6 months may lapse between injections. Give boosters at ages 1-1/2 and 3 years, then adult type diphtheria-tetanus vaccine until age 12, as indicated in preceding table.

a. Precautions:

- 1) Defer in presence of any active infection.
- 2) In infant who has had febrile convulsions, start with fractional doses, and give aspirin.
- 3) If previous injection has produced high fever, somnolence, or unusual reactions, reduce dosage subsequently.
- 4) If convulsion or other severe reaction has occurred, discontinue pertussis, and try fractional doses of separate diphtheria and tetanus antigens.
- 5) Presence of cerebral damage is an indication for delaying active immunization until after 1 year of age. Use fractional doses with single antigens.

b. Special Situations:

- 1) If child has had proven pertussis, use D-T only. (Parapertussis has no cross-immunity.)
- 2) Over age 3 years use D-T antigen ("adult type"). Using 0.5 ml dosage, preliminary Schick and toxoid sensitivity tests are unnecessary.
- 3) To attempt rapid immunization of young infants in the face of a pertussis outbreak, use fluid pertussis vaccine, 0.5 ml subcutaneously once a week x 3. This schedule does not provide as good immunity as longer spacing or depot vaccines.

c. Guide to Tetanus Prophylaxis in Wound Management:

History of Tetanus Immunization (Doses)	Clean, Minor Wounds		All Other Wounds	
	Toxoid	Tetanus Immune Globulin	Toxoid	Tetanus Immune Globulin
Uncertain	Yes	No	Yes	Yes
0-1	Yes	No	Yes	Yes
2	Yes	No	Yes	No ₁
3 or more	No ₂	No	No ₃	No

1. Unless wound more than 24 hours old.
2. Unless more than 10 years since last dose.
3. Unless more than 5 years since last dose.

Ref: U.S.P.H.S.: Weekly Morbidity and Mortality Report, Vol. 20, No. 43, 1971.

2. Poliomyelitis

Live Vaccine: provided as trivalent vaccine and administered orally only. Storage and dose instructions vary with manufacturer and must be adhered to. Immunization of infants may be started as young as 6 weeks of age, but a combined dose of all three types is recommended six months later to allow multiplication of any one type which might have been suppressed by passive immunity of infancy. Contraindications are acute illness, severe debilitation, and gastroenteritis, which may interfere with establishment of infection. Trivalent boosters are currently given at 18 months and 5 years.

Killed Vaccine: Not recommended except where live vaccine is contraindicated (see Measles below) or in immune deficiency diseases.

3. Measles

Give live, attenuated measles virus vaccine 0.5 cc SC (Schwartz or Moraten) into deltoid.

Contraindications:

- a. Leukemia and other malignancies
- b. Febrile illness
- c. History of egg sensitivity
- d. Defer during polio epidemic
- e. Pregnancy
- f. When PPD positive, vaccine may be given, but the patient should be placed on anti-tuberculous therapy prior to vaccination.

NOTE: Systemic manifestations may occur between the 5th and 12th day.

4. Smallpox

No longer routinely recommended but suggested for people at high risk such as travelers to and from countries where smallpox is endemic as well as for health service personnel.

Ref: U.S.P.H.S.: Weekly Morbidity and Mortality Report, Vol. 20, No. 38, 1971.

Use calf lymph virus, kept frozen until use, and the multiple puncture technique, over the insertion of the left deltoid. The lesion should be kept dry, and no dressing used. Inspect primary vaccinations at 8 to 10 days, and revaccinations at 4 to 7 days.

- a. Primary Vaccinia: Maximal erythema in 8 to 14 days. Progression: Vesicle to pustule to crust to scar. Indicates complete absence of previous immunity.
- b. Vaccinoid Reaction: Maximal erythema in 4 to 7 days. Virus propagation occurs but is terminated by accelerated recall of immunity. Usually a mild scar is produced.
- c. Early Reaction: Maximal erythema between 8 and 72 hours. No scar produced. This reaction indicates good immunity only if the lot of vaccine is proven to be live by production of primary vaccinia in other patients. If virus is dead, this reaction indicates sensitivity to protein but not necessarily immunity.
- d. No Reaction: An indication of an unsuccessful attempt, not of immunity, and should be repeated.

Special Situations:

- 1) Annual vaccination is necessary for optimal protection as in endemic areas.
- 2) The Surgeon General recommends vaccination of medical personnel every three years because of present rapid world-wide travel.
- 3) Rapid recall is best produced by revaccination on the flexor surface of the forearm. (See also passive immunization.)

Contraindications to Vaccination:

- 1) Dermatitis (especially eczema) in the patient or his household.

- 2) Steroid, x-ray, and antimetabolite therapy are contraindications as are certain neoplastic diseases and immunologic deficiency diseases.
- 3) Pregnancy.

Complications of Vaccination: See Current Pediatric Therapy for list of individuals with access to vaccinia immune globulin.

5. Influenza

Bivalent A2 and B vaccine (700 CCA units/ml): Primary course is 2 injections, given subcutaneously except when the dose is less than 0.2 ml, in which case better response is obtained with intradermal injection. Age 3 months to 6 years: 0.1 to 0.2 ml at 1 to 2 week interval, with a booster 3 months later. Age 6 to 12 years: 0.5 ml on 2 occasions 2 or more months apart. Adults: 1.0 ml on 2 occasions 2 or more months apart. Give a booster each fall. This vaccine is contraindicated in patients with egg sensitivity.

Indications: Not routinely recommended for pediatric patients. Every year in patients with chronic debilitating cardiovascular, pulmonary, renal or metabolic disorders, especially congenital heart disease, cystic fibrosis, Addison's disease, chronic asthma, TB, diabetes. Also recommended for pregnant women. In epidemic years many other groups may be candidates for immunization, depending on current opinion.

6. Mumps

Inactivated: Not recommended for routine use in healthy children. Degree and duration of immunity not clearly established.

Live Attenuated: Recommended for children approaching puberty, adolescents and adults who have not had clinical disease. Given SC only after excess antiseptic cleaned off skin.

Contraindications:

- a. Egg sensitivity.
- b. Agammaglobulinemia.
- c. Patients with malignancies, or on anti-metabolites or steroids.
- d. Pregnancy.

7. Rabies

After severe exposures to potentially rabid animals (particularly following bites about the head and neck), individuals should be

given equine antirabies serum. Appropriate conjunctival and skin tests should be carried out with this product. Serum dosage is obtained from the brochure supplied by the manufacturer with each vial. It should always be followed by active immunization. Active immunization should consist of 14 daily injections of the avian vaccine supplemented by two booster doses of avian vaccine 10 and 20 days after the last of the daily doses.

8. Rocky Mountain Spotted Fever

Recommended only for high risk persons. Cox yolk sac vaccine in 3 SC injections of 0.5 ml each at 5 to 7 days intervals. An annual stimulating dose will maintain a high level of protection. Do not give to those sensitive to egg.

9. Rubella

Live rubella vaccine is currently recommended by the American Academy of Pediatrics. It should be given to boys and girls between 1 year of age and puberty. It is contraindicated in pregnancy. Opinions vary as to its efficacy in establishing permanent immunity.

10. Tuberculosis

BCG is given only when the PPD is negative. 0.1 ml is given subcutaneously, as superficially as possible, over the right deltoid, or by the multiple puncture technique of Rosenthal. The PPD should be repeated 12 weeks after vaccination and periodically; if negative at 12 weeks, BCG is considered to have failed and should be repeated.

a. Indications:

- 1) Newborns at risk of exposure at home should be vaccinated in the nursery and kept from exposure until PPD positive.
- 2) Children who have been exposed to TB but who can be isolated from exposure for 8 weeks prior to vaccination, who then still have a negative PPD, and who can be isolated following vaccination until PPD converts.

- ##### b. Contraindications: Premature infants or persons suffering from agammaglobulinemia, burns, impetigo or other infectious skin diseases. Do not administer BCG simultaneously with smallpox.

11. Typhoid

Saline suspension of 10^9 killed organisms/ml, given in a course of 3 injections, 1 to 4 weeks apart, subcutaneously. Under 1 year: Total dose 1.0 ml, divided 0.2; 0.4; 0.4. Over 1 year: Total dose 1.5 ml, divided 0.3; 0.5; 0.7. If febrile reactions occur, divide the total dose into smaller fractions. Recall: 0.1 ml intradermally every 1 to 2 years or on exposure. Evidence of efficacy still not convincing.

Indications:

- a. Presence of epidemic.
- b. Residency in rural endemic area.

NOTE: Use typhoid-paratyphoid vaccine for travelers abroad. The dosage schedule is as above, but febrile reactions are more common.

B. PASSIVE IMMUNIZATION

1. Infectious Hepatitis

Usual recommendation is 0.02 to 0.04 ml/kg gamma globulin IM for both children and adults. Repeat dosage q6 weeks if exposure continues.

2. Measles

Preventive dose: 0.25 ml/kg gamma globulin IM as soon after exposure as possible. Indicated for children who (1) are under 3; (2) are hospitalized; (3) are chronically ill; (4) have siblings with other diseases (especially TB, pertussis, rheumatic fever).

Modifying dose: 0.05 ml/kg within 6 days of exposure. Indicated for all children and adults with negative histories. After an interval of at least 6 weeks active immunization with live vaccine should be given where not contraindicated.

3. Pertussis

In non-vaccinated children under the age of 2, pertussis immune gamma globulin (human), 2.5 ml is harmless (as opposed to hyper-immune human serum), but this preparation is of no proven value in either prophylaxis or treatment.

4. Rubella

20 ml gamma globulin for pregnant women exposed during the first trimester is of questionable benefit since rash can be suppressed without preventing viremia and teratogenesis.

5. Tetanus

Allergic reactions are frequent following the use of horse serum antitoxin in tetanus prophylaxis; often the reactions are severe, occasionally they are fatal. Various alternatives such as rapid active immunization and antibiotic prophylaxis have become popular in order to avoid administering horse serum. Human tetanus hyperimmune gamma globulin (HTG) has been marketed recently, making it possible to dispense with horse antitoxin entirely.

More widespread active immunization with tetanus toxoid is strongly recommended, for active immunization before the injury obviates the need for antitoxin. If active immunization is begun after the injury (see page 193), and if HTG is also to be given at the same time it is best to use 0.5 ml fluid toxoid, waiting 3 hours before giving HTG into the other arm. Precipitated toxoids should be avoided in this situation.

HTG is more expensive than horse antitoxin, but not prohibitively so, and the increased expense is offset by the virtual elimination of allergic reactions. Because it is a homologous protein, it disappears from the serum more slowly than horse antitoxin; thus, smaller amounts are effective. A dose of 250 units HTG appears adequate in children and adults. This seems equivalent to at least 1500 units of horse antitoxin, and it gives protection for at least 1 month. It should be given intramuscularly only. This material does not transmit serum hepatitis. Antitoxin is only an adjunct to careful and thorough surgical treatment of tetanus-prone wounds.

Ref: New Eng. J. Med., 270:175, 1964.
New Eng. J. Med., 268:857, 1963.

6. Vaccinia and Smallpox

Vaccinia immune gamma globulin is now available through consultants to the American Red Cross.

Indications: Eczema vaccinatum, generalized vaccinia, vaccinia necrosum, ocular autoinoculation of vaccinia, and in conjunction with vaccination in all cases of known smallpox exposure. It has also been demonstrated to be effective in prophylaxis of children with eczema who must be vaccinated, and of children who are burned or developed varicella soon after vaccination. It has not been effective in the treatment of vaccinia encephalitis.

INCUBATION PERIODS AND ISOLATION PERIODS
FOR SOME COMMON CONTAGIOUS DISEASES

Disease	Duration of Average Incubation Period	Isolation of Patient	Observation or Quarantine of Susceptible Patients
Chickenpox	12-16 days	Until pustules and most scabs gone, usually about 7 days.	11-17 days from first exposure.
Diphtheria	First week, usually 2-4 days	Until two successive negative cultures of nose and throat are obtained, taken no less than 24 hours apart, nor before 7th day.	Observation for 7 days from last contact or until negative culture is obtained. Schick test for all contact.
Rubeolla	Second week, usually about 10 days	Until 5 days after appearance of rash.	Observation 14 days from last exposure.
Meningococcus meningitis	First week	Duration of febrile period, or first 24 hours of effective antibiotic therapy.	Observation for 7 days from last exposure.
Mumps	Third week	Duration of swelling.	Observation during third week from first exposure.
Poliomyelitis	7-14 days	Duration of febrile period.	Observation for 2 weeks for any minor illness.
Parvella	Irregular, usually the third week	Duration of catarrh and rash	Observation 12th-20th days.

Incubation Periods and Isolation Periods for Some Common Contagious Diseases (continued)

Disease	Duration of Average Incubation Period	Isolation of Patient	Observation or Quarantine of Susceptible Patients
Scarlet fever	First week, usually 2-4 days	Until infection cured, at least 7 days.	Observation until 1 week from last exposure.
Smallpox	Second week, usually about 12 days	Until all crusts and scabs are gone.	Quarantine 3 weeks. Rules modified by vaccination.
Pertussis	Beginning of second week	Until 1 week after last paroxysm with vomiting.	For 2 weeks from last exposure. Quarantine for unvaccinated under 5 years; observation for others.

ISOLATION TYPES AND TECHNIQUES

RESPIRATORY		ENTERIC ⁴		SPECIAL		PROTECTIVE
DISEASE	Bacterial meningitis ² Zoster-Chickenpox Tuberculosis Measles (Rubeola) Diphtheria Pertussis Measles (Rubella) ³ Staph pneumonia	Staph enteritis Shigella Salmonella Infant diarrhea ⁵ Aseptic meningitis Cocksackie Polio ECHO Serum Hepatitis ⁶ Infectious	Staph wounds Puerpera sepsis ⁴ Pelvic infections (draining) ⁴	Tetanus Gas bacillus Septic wounds Eye infections	Vaccinia Smallpox	Thermal burns ⁸ Hyper-sus- ceptibility
	Handwashing	Upon leaving room	Upon leaving room	Upon leaving room	Upon leaving room	Upon leaving room
	Single Room	Yes	Yes	Yes	Not neces. Yes ⁷	Yes
	Gown	Yes	Yes	Yes	No	Yes
	Mask	Yes	No	Staph wounds only	No	Yes

Isolation Types and Techniques (Continued)

	RESPIRATORY	ENTERIC ⁴	SPECIAL	PROTECTIVE
Gloves ¹	No	No	To handle soiled linen and dressings	No
Care of Articles	To be discarded; or washed and disinfected; or wrapped for sterilization.			Treat as non-isolation

1. Use plastic disposable isolation-type.
2. Isolate until 24 hours after onset of treatment.
3. Pregnant nursing personnel should not care for these patients. Urine of congenitally infected infants is infected.
4. Bedpan precautions for all patients.
5. Infant diarrhea may be grouped.
6. Syringe and needle precautions.
7. Room should not be used for eczema patient for one year after these patients have occupied it.
8. Use sterile gowns and linen.

K E T O G E N I C D I E T

The ketogenic diet is a dietary regimen that may be of value in the treatment of intractable grand mal or minor motor seizures. Best results are obtained in children 2-5 years of age, but it may be tried up to 8 years of age or beyond and before 2 years of age. It is usually reserved for those uncontrolled by usual anticonvulsant drugs. Adequate parental supervision and some cooperation by the patient are essential.

1. Method of Starting Diet

- a. An initial period of starvation to establish adequate ketosis is necessary. This lasts a minimum of 3 days, usually 5-7 days. Unless untoward reactions occur, intake is limited to 400-800 cc water per day. The diet is begun after the patient has lost 10% of body weight, and the urinary acetone and diacetic acid tests have been 4+ for several days.
- b. One-third of the calculated diet is offered on the first day, and then increased to 2/3, and finally to full rations on successive days, if the ketosis is not appreciably lessened.
- c. Evaluation of the patient is both by clinical and by laboratory means. Routine to be followed includes:
 - 1) Pulse and respirations q4h.
 - 2) Daily morning weights (ac, after voiding).
 - 3) Urine specimens (ac, breakfast and supper) for urine specific gravity, acetone, and diacetic acid, daily.
 - 4) Fasting blood sugar, CO₂, K, and uric acid to be studied on day of starvation and repeated in 3 days and on day of discharge.

NOTE: Appropriate measures are taken for symptoms of hypoglycemia or marked acidosis.

- d. If anticonvulsant drugs are being given, they may be tapered. If phenobarbital is used, it should be continued to the first ketogenic diet meal, and then eliminated gradually over the next 2 weeks. If other drugs are being used with phenobarbital, they may be discontinued when the starvation is begun. If phenobarbital is not employed, but other drugs are, they may be reduced daily and discontinued by the end of the starvation period. Drugs should not be administered in a carbohydrate vehicle.

2. Composition and Calculation of the 4:1 Diet

- a. The diet consists of 4 grams of fat (ketogenic), 1 gram of protein and carbohydrate combined (antiketogenic).
- b. Method of Calculation:
 - 1) The 4 gm of fat plus 1 gm of protein plus CHO are considered a "dietary unit," and yield 40 calories.
 - 2) Daily caloric requirement is 60-75 cal/kg/day, depending on age.
 - 3) Determine number of "dietary units" required per day; i.e., total daily caloric requirements divided by 40.
 - 4) Calculate gm of fat/day (number of "dietary units" x 4).
 - 5) Calculate gm of protein/day on basis of about 1 gm/kg/day.
 - 6) Obtain gm of CHO/day by difference.
- c. Example (for a 5-year-old, weighing 18 kg)
 - 1) Daily requirement: $18 \text{ kg} \times 70 \text{ cal/kg} = 1260 \text{ cal/day}$.
 - 2) Number of "dietary units": $1260 \text{ cal} \div 40 \text{ cal/unit} = 31.5 \text{ units}$.
 - 3) Number of grams of fat: $31.5 \text{ units} \times 4 \text{ gm fat/unit} = 126 \text{ gm}$.
 - 4) Number of grams of protein: $1.0 \text{ gm/kg} \times 18 \text{ kg} = 18 \text{ gm}$.
 - 5) Number of grams CHO: 31.5 gm (since protein plus CHO = 1 gm/unit) minus $18 = 13.5 \text{ gm}$.
- d. NOTE: Hyperuricemia during induction of diet may precipitate renal stones.

3. Method of Discontinuing Diet

After 2 years on the 4:1 ratio, the diet is reduced to a 3:1 (ketogenic:antiketogenic) ratio from 3 months to 1 year, and finally to a 2:1 ratio for another three months, after which time a normal diet is resumed.

NOTE: Urine should be checked daily for ketone bodies while on diet as abruptly breaking out of ketosis may precipitate recurrence of seizures.

PART IV

REFERENCE DATA



NORMAL MEASUREMENTS BY AGE

	MALE				FEMALE				BOTH SEXES	
	HEIGHT	WEIGHT	UPPER SEGMENT	U/L ratio	HEIGHT	WEIGHT	UPPER SEGMENT	U/L ratio	HEAD	CHEST
	cm.	kg.	cm.		cm.	kg.	cm.		cm.	cm.
BIRTH										
1/12	50.8	3.4	32.0	1.70	50.8	3.2	32.0	1.70	35.1	34.8
2/12	53.6	4.3	33.5	1.67	54.6	4.1	34.3	1.69	36.3	36.3
3/12	56.4	5.1	35.3	1.67	57.2	5.0	35.8	1.68	37.8	37.8
4/12	59.2	6.0	36.8	1.64	59.7	5.9	37.3	1.67	39.1	39.4
5/12	61.7	6.8	38.4	1.64	62.0	6.6	38.6	1.65	40.4	40.9
6/12	64.5	7.6	39.9	1.62	64.0	7.3	39.6	1.62	41.7	42.4
7/12	67.3	8.5	41.7	1.62	65.5	7.7	40.4	1.61	43.2	43.9
8/12	68.8	8.9	42.4	1.61	67.1	8.2	41.1	1.59	43.7	44.5
9/12	70.4	9.3	43.2	1.59	68.6	8.6	41.9	1.57	44.2	44.7
10/12	71.9	9.6	43.9	1.57	70.1	9.0	42.7	1.56	45.0	45.2
11/12	73.2	10.0	44.7	1.57	71.4	9.3	43.2	1.53	45.5	45.7
12/12	74.7	10.4	45.5	1.56	72.9	9.6	43.9	1.52	46.0	46.0
	76.2	10.8	46.2	1.54	74.2	10.0	44.7	1.52	46.5	46.5
1 & 1/12	77.2	11.0	46.7	1.53	75.2	10.2	45.2	1.51	46.7	46.7
2/12	78.0	11.3	47.0	1.52	76.2	10.5	45.7	1.50	47.0	47.0
3/12	79.0	11.5	47.5	1.51	77.2	10.7	46.2	1.49	47.2	47.2
4/12	79.8	11.8	48.0	1.51	78.2	10.9	46.7	1.48	47.8	47.5
5/12	80.8	12.0	48.5	1.50	79.2	11.1	47.2	1.48	48.0	47.8
6/12	81.8	12.2	49.0	1.50	80.0	11.4	47.5	1.46	48.3	48.0
7/12	82.8	12.4	49.5	1.49	81.0	11.6	47.8	1.44	48.3	48.3
8/12	83.8	12.6	50.0	1.48	82.0	11.8	48.3	1.43	48.5	48.5
9/12	84.6	12.8	50.0	1.45	83.1	12.0	48.8	1.42	48.5	48.8

NORMAL MEASUREMENTS BY AGE (continued)

	MALE			FEMALE			BOTH SEXES	
	HEIGHT cm.	WEIGHT kg.	UPPER SEGMENT cm.	UPPER SEGMENT cm.	WEIGHT kg.	HEIGHT cm.	HEAD cm.	CHEST cm.
10/12	85.6	12.9	50.5	35.1	12.2	84.1	49.3	48.5
11/12	86.6	13.1	51.1	35.6	12.4	85.1	49.8	48.8
12/12	87.4	13.3	51.3	36.1	12.5	86.1	50.3	48.8
2 & 6/12	92.2	14.3	53.3	38.9	13.7	91.2	52.3	49.3
3	96.5	15.2	55.1	41.4	14.8	95.5	54.0	49.8
3 & 6/12	100.8	16.3	56.6	43.4	15.9	99.6	55.6	50.0
4	103.9	17.3	57.7	46.2	16.9	103.4	56.9	50.3
4 & 6/12	107.2	18.2	58.9	48.3	18.2	107.2	58.4	50.5
5	110.7	19.5	59.9	50.8	19.2	110.5	59.2	50.8
5 & 6/12	114.3	20.7	61.2	53.9	20.6	114.0	60.5	51.1
6	117.6	21.9	62.2	55.4	22.0	117.6	61.7	51.3
6 & 6/12	120.7	23.2	63.0	57.7	23.4	120.7	62.7	51.6
7	123.7	24.6	64.0	59.7	24.8	123.7	63.7	52.1
7 & 6/12	126.7	26.2	65.0	61.7	26.5	126.7	64.8	52.3
8	129.8	27.7	65.8	64.0	28.1	129.8	66.0	52.3
8 & 6/12	132.6	29.4	67.1	65.5	29.9	132.6	67.3	52.6

NORMAL MEASUREMENTS BY AGE (continued)

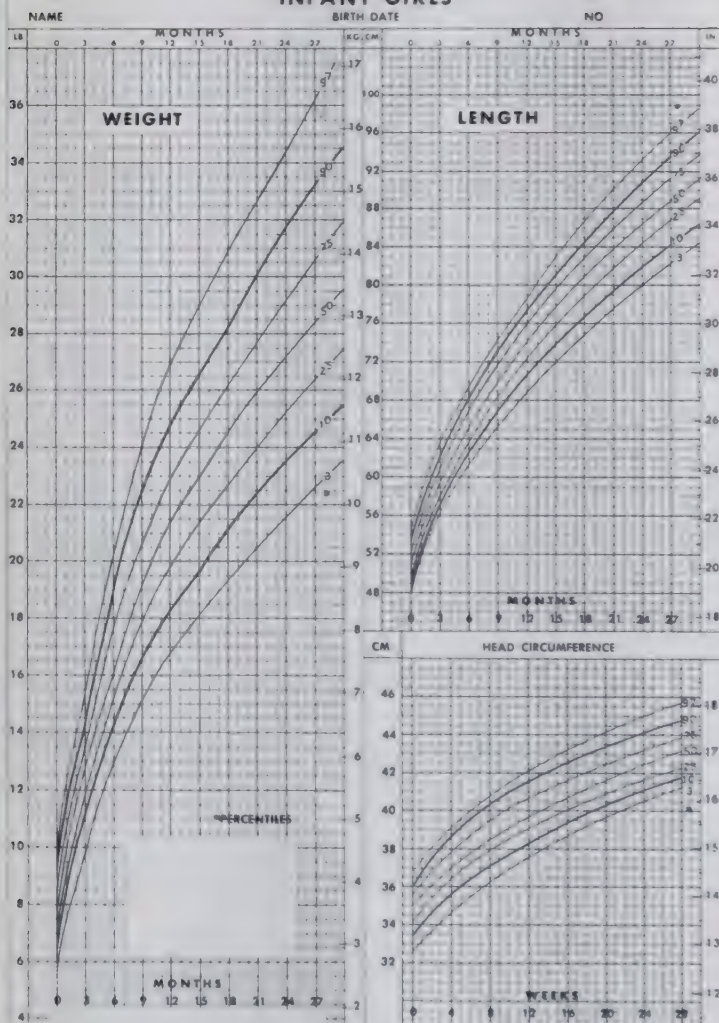
	MALE				FEMALE				BOTH SEXES			
	HEIGHT cm.	WEIGHT kg.	UPPER SEGMENT cm.	LOWER SEGMENT cm.	U/L ratio	HEIGHT cm.	WEIGHT kg.	UPPER SEGMENT cm.	LOWER SEGMENT cm.	U/L ratio	HEAD cm.	CHEST cm.
9	135.4	31.1	68.3	67.1	1.02	135.4	31.6	68.3	67.1	1.02	52.6	62.2
9 & 6/12	138.2	33.0	69.1	69.1	1.00	138.2	33.5	69.6	68.6	1.01	52.8	63.0
10	141.0	34.9	70.1	70.9	0.99	141.0	35.5	70.6	70.4	1.00	52.8	63.8
10 & 6/12	143.3	36.9	70.9	72.4	0.98	144.3	37.8	72.1	72.1	1.00	53.1	65.0
11	145.8	38.9	72.1	73.7	0.98	147.6	40.2	73.4	74.2	0.99	53.1	66.3
11 & 6/12	148.6	41.1	73.4	75.2	0.98	150.9	42.9	75.2	75.7	0.99	53.3	67.6
12	151.4	43.3	74.9	76.5	0.98	154.2	45.6	76.7	77.5	0.99	53.3	68.6
12 & 6/12	154.4	45.7	76.5	77.9	0.98	157.0	47.9	78.2	78.7	0.99	53.6	69.9
13	157.5	48.0	77.7	79.8	0.97	159.5	50.2	79.8	79.8	1.00	53.8	71.1
13 & 6/12	161.3	51.1	79.5	81.9	0.97	161.0	52.4	80.5	80.5	1.00	54.1	72.4
14	164.8	54.1	81.3	83.6	0.97	162.8	54.6	81.8	81.0	1.01	54.6	73.7
14 & 6/12	167.9	57.1	82.8	85.1	0.97	163.8	56.3	82.3	81.5	1.01	54.9	75.2
15	171.2	60.1	84.8	86.4	0.98	164.8	57.5	82.8	82.0	1.01	55.4	77.0
15 & 6/12	173.2	62.3	86.1	87.1	0.99	165.1	58.4	83.1	82.0	1.01	55.4	77.0
16	175.3	64.5	87.4	87.9	0.99	165.6	59.3	83.3	82.3	1.01	55.6	80.5
16 & 6/12	176.0	65.8	87.6	88.4	0.99	165.6	60.0	83.3	82.3	1.01	55.9	82.0
17	176.5	67.1	87.6	88.6	0.99	165.6	60.7	83.3	82.3	1.01	55.9	83.8

GROWTH CHARTS

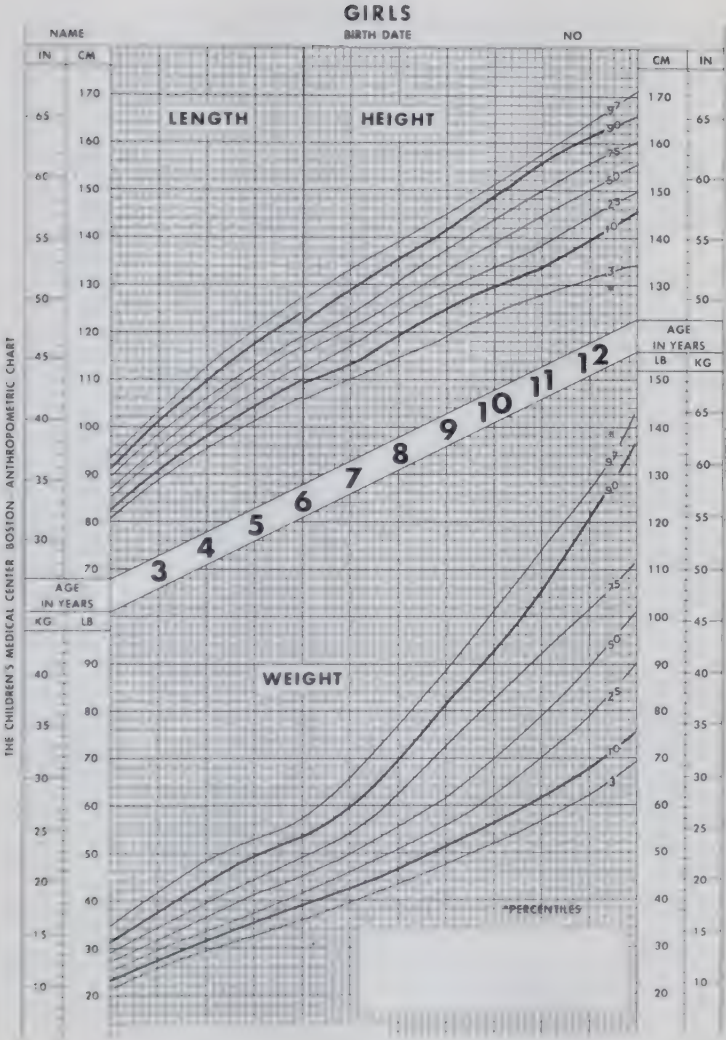
INFANT GIRLS

THE CHILDREN'S MEDICAL CENTER, BOSTON - ANTHROPOMETRIC CHART

FORM 103



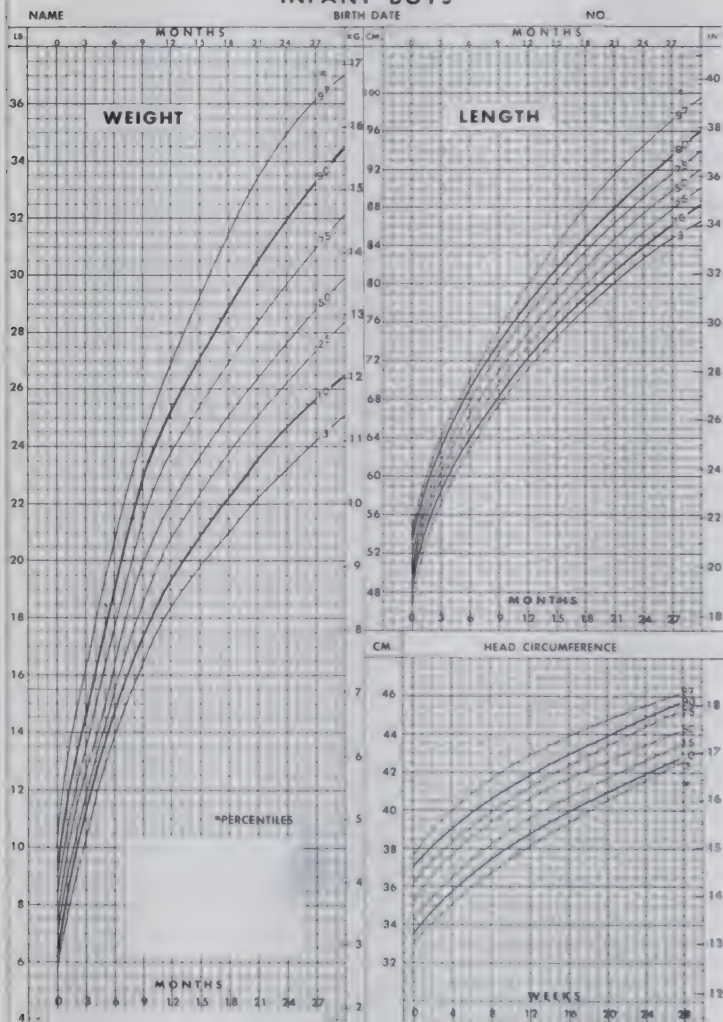
GROWTH CHARTS



GROWTH CHARTS

INFANT BOYS

THE CHILDREN'S MEDICAL CENTER, BOSTON - ANTHROPOMETRIC CHART



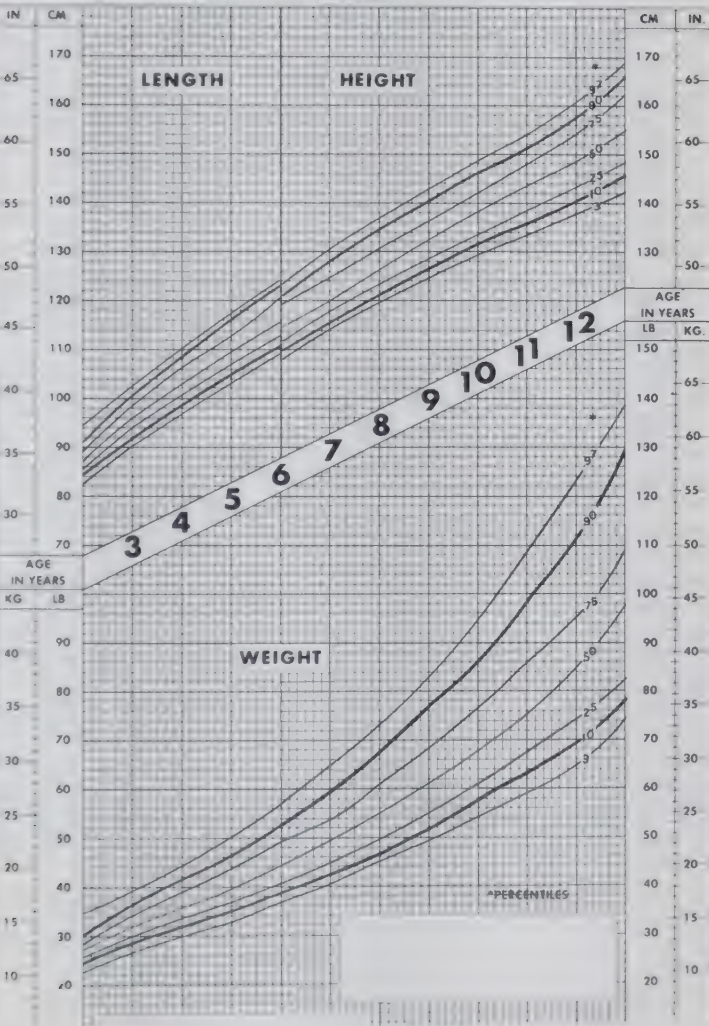
GROWTH CHARTS

BOYS

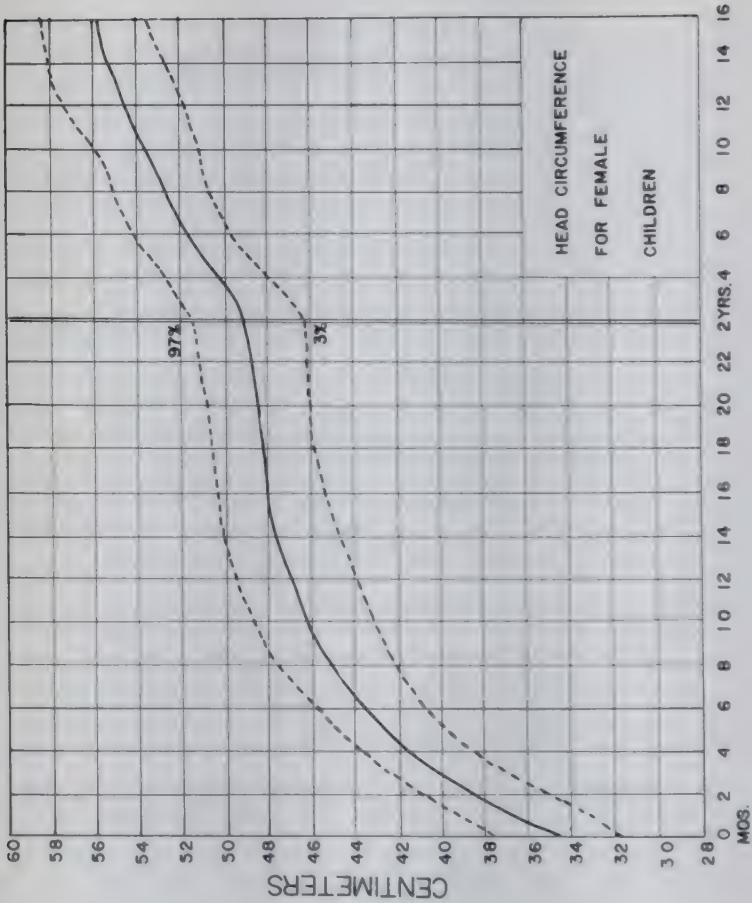
NAME

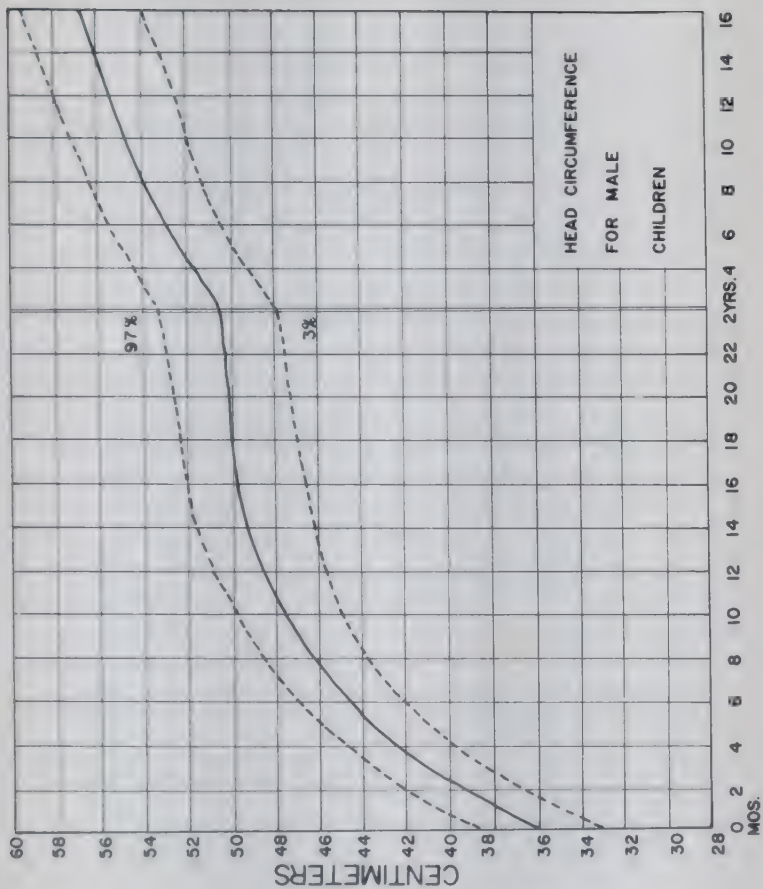
BIRTH DATE

NO



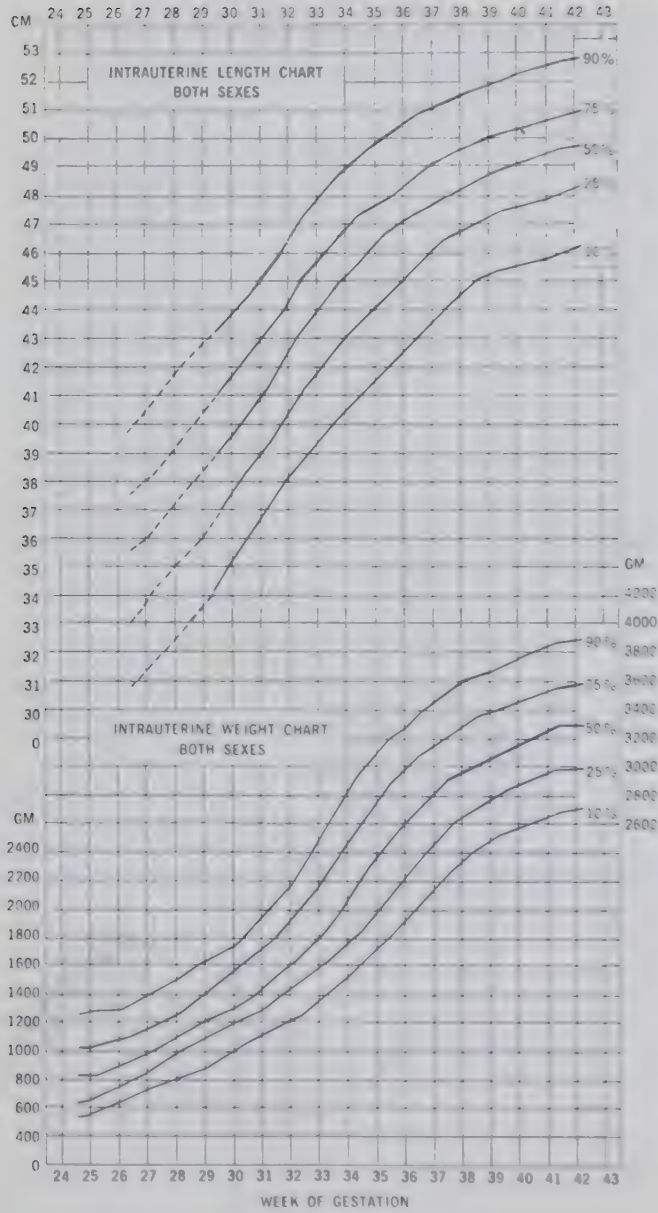
THE CHILDREN'S MEDICAL CENTER, BOSTON - ANTHROPOMETRIC CHART





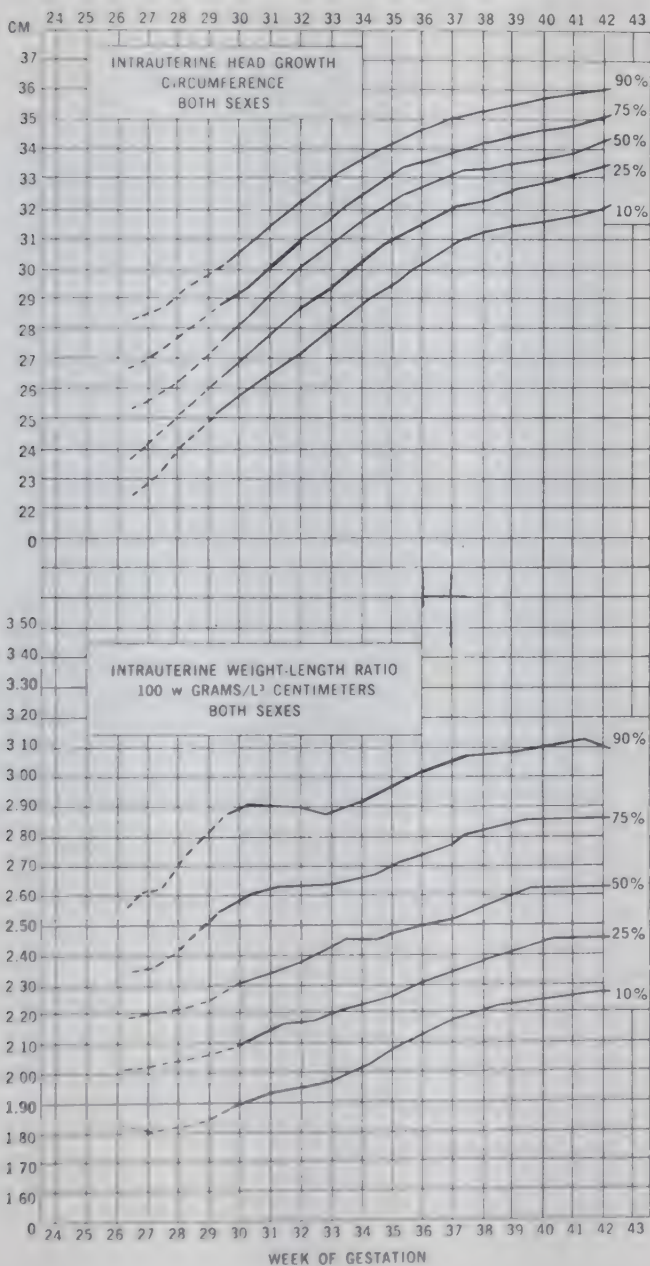
INTRAUTERINE GROWTH

Length and Weight

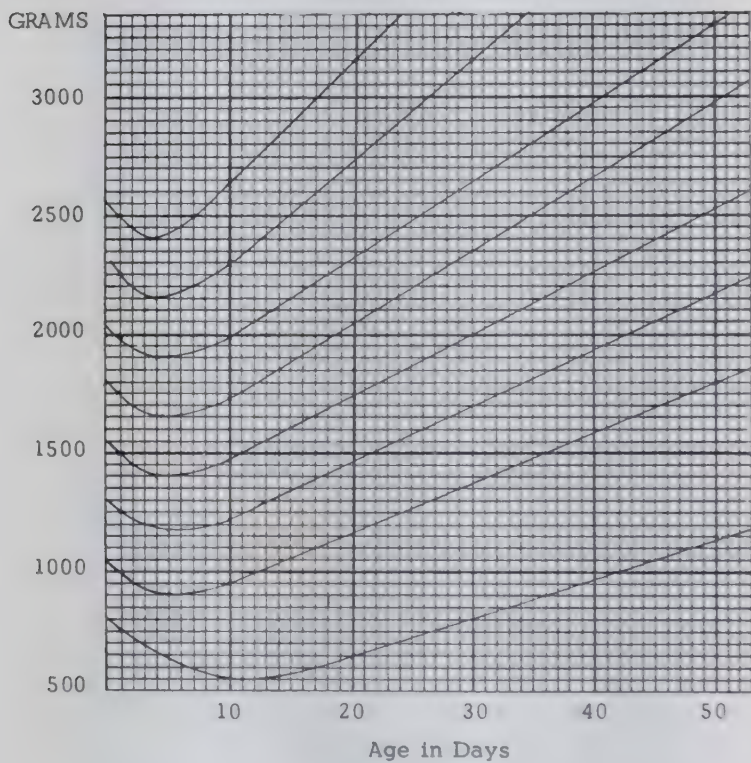


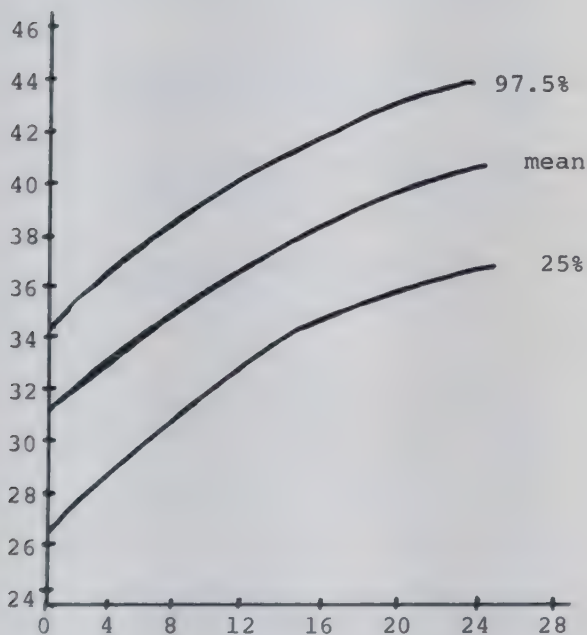
From Lubchenco, L.O., et al.: Pediatrics 37:403, 1966.

INTRAUTERINE GROWTH Head Circumference and Weight/Length Ratio



PREMATURE GROWTH CHART



HEAD CIRCUMFERENCE/AGE CHART
FOR PREMATURES

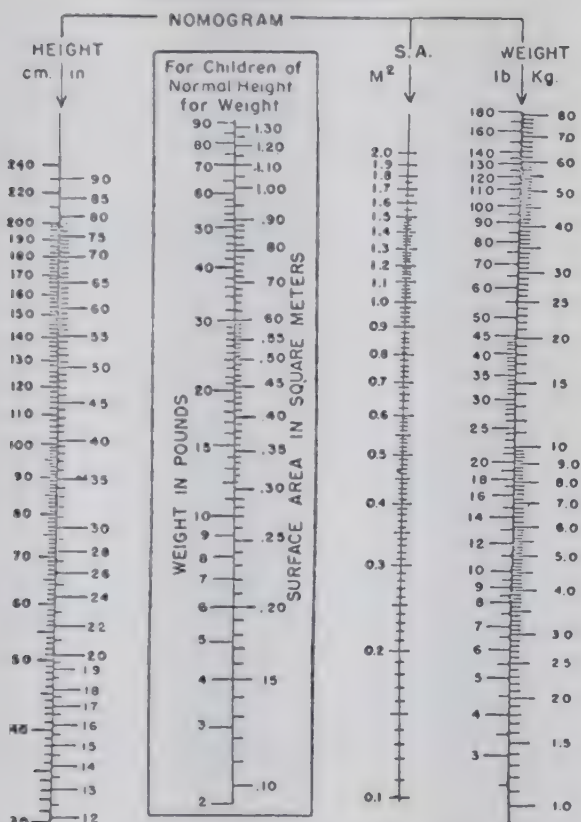
Ref: Arch. Dis. Child., 36:241, 1961.

PARENT-SPECIFIC AGE-SIZE TABLES FOR BOYS AND GIRLS
OF THREE SELECTED MIDPARENT VALUES

BOYS					GIRLS				
Parental Midpoint					Parental Midpoint				
Age	163 cm	169 cm	175 cm		Age	163 cm	169 cm	175 cm	
1-0	73.1	75.1	77.1		1-0	73.0	74.0	74.6	
2-0	85.4	87.4	88.9		2-0	84.0	85.5	88.2	
3-0	93.2	96.0	98.3		3-0	90.4	93.8	96.5	
4-0	99.5	103.1	106.3		4-0	96.8	103.9	103.8	
5-0	105.6	110.0	112.7		5-0	103.5	109.1	111.0	
6-0	110.9	115.4	118.7		6-0	110.2	115.0	117.3	
7-0	116.2	121.3	124.6		7-0	116.5	120.2	124.0	
8-0	121.6	126.8	130.4		8-0	122.4	125.8	130.2	
9-0	126.9	131.9	136.0		9-0	128.6	131.4	136.6	
10-0	132.5	137.4	141.5		10-0	135.1	136.9	143.1	
11-0	138.5	143.0	146.8		11-0	141.6	143.4	149.6	
12-0	144.7	148.4	152.4		12-0	147.8	150.3	155.8	
13-0	151.0	154.9	159.6		13-0	154.2	157.0	161.7	
14-0	158.8	161.6	167.8		14-0	158.8	160.4	165.9	
15-0	165.8	167.9	174.7		15-0	159.8	162.2	168.4	
16-0	169.4	172.8	176.6		16-0	160.5	163.4	169.7	
17-0	170.9	175.4	177.8		17-0	160.8	164.0	170.9	
18-0	171.5	176.2	178.6		18-0	161.0	164.3	171.8	

The values shown are based on fully longitudinal analyses of the stature growth of more than 500 children representing in excess of 12,000 observations in all. The midparent value, here the average of paternal and maternal statures, refers to parental size at age thirty. To use, determine the midparent stature and present age of the child in question, reading out in the sex-appropriate column. Ref: Garn, S. M. and Rohmann, G. G. *Ped. Clin. N. Amer.* 13:353, 1966.

SURFACE AREA NOMOGRAM



Nomogram for estimation of surface area. The surface area is indicated when a straight line which connects the height and weight levels intersects the surface area column; or if the patient is roughly of average size, from the weight alone (enclosed area). (Nomogram modified from data of E. Boyd by C. D. West.)

OSSIFICATION CENTERS	Boys		Girls	
	Percentiles		Percentiles	
	5th	50th	5th	50th
<u>Knee</u>				
Proximal tibia	birth	2w	birth	2w
Proximal fibula	1y 10m	3y 6m	1y 4m	2y 7m
Patella	2y 7m	4y	1y 6m	2y 6m
Tibial tubercle	9y 11m	11y 10m	7y 11m	10y 3m
				11y 10r
<u>Foot</u>				
Cuboid	birth	1m	birth	3w
Third cuneiform	3w	6m	birth	3m
Os calcis	5y 2m	7y 7m	3y 6m	5y 4m
				7y 4m

*Modified from Garn, S.M., Rohman, C.G., and Silverman, F.N.: Medical Photography 43:45, 1967.

STANDARD ATLASES

Hand: Greulich, W.W. and Pyle, S.I.: Radiographic Atlas of Skeletal Development of the Hand and Wrist. Stanford University Press, Stanford, California, Second Edition, 1959.

Knee: Pyle, S.I. and Hoerr, N.L.: Radiographic Standard Reference for the Growing Knee. Charles C. Thomas, Springfield, Illinois, 1969.

AGE OF ERUPTION OF DECIDUOUS TEETH

PRIMARY OR DECIDUOUS TEETH

	Calcification		Eruption		Shedding	
	Begins at	Complete at	Maxillary	Mandibular	Maxillary	Mandibular
Central incisors	5th fetal mo.	18-24 mos.	6-8 mos.	5-7 mos.	7-8 yrs.	6-7 yrs.
Lateral incisors	5th fetal mo.	18-24 mos.	8-11 mos.	7-10 mos.	8-9 yrs.	7-8 yrs.
Cuspid	6th fetal mo.	30-36 mos.	16-20 mos.	16-20 mos.	11-12 yrs.	9-11 yrs.
First molars	5th fetal mo.	24-30 mos.	10-16 mos.	10-16 mos.	10-11 yrs.	10-12 yrs.
Second molars	6th fetal mo.	36 mos.	20-30 mos.	20-30 mos.	10-12 yrs.	11-13 yrs.

Sexes are combined although girls tend to be slightly advanced over boys.

Averages are approximate values derived from various studies.

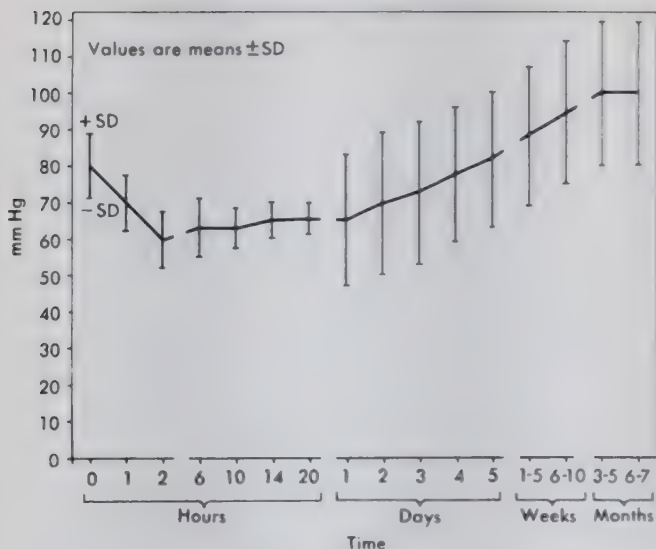
AGE OF ERUPTION OF
SECONDARY OR PERMANENT TEETH

SECONDARY OR PERMANENT TEETH

	Calcification		Eruption	
	Begins at	Complete at	Maxillary	Mandibular
Central incisors	3-4 mos.	9-10 yrs.	7-8 yrs.	6-7 yrs.
Lateral incisors	Max., 10-12 mos. Mand., 3-4 mos.	10-11 yrs.	8-9 yrs.	7-8 yrs.
Cuspid	4-5 mos.	12-15 yrs.	11-12 yrs.	9-11 yrs.
First premolars	18-21 mos.	12-13 yrs.	10-11 yrs.	10-12 yrs.
Second premolars	24-30 mos.	12-14 yrs.	10-12 yrs.	11-13 yrs.
First molars	Birth	9-10 yrs.	6-7 yrs.	6-7 yrs.
Second molars	30-36 mos.	14-16 yrs.	12-13 yrs.	12-13 yrs.
Third molars	Max., 7-9 yrs. Mand., 8-10 yrs.	18-25 yrs.	17-22 yrs.	17-22 yrs.

Ref: Nelson, Waldo E. Textbook of Pediatrics, 1964.

BLOOD PRESSURE



Mean systolic blood pressure in the first seven months. The mean is plotted along with two standard deviations. (Reproduced from Goodman, H. G., Cummings, G. R., and Raber, M. B.: Photocell oscillometer for measuring systolic pressure in newborn. Amer. J. Dis. Child., 103: 152, 1962.)

NORMAL BLOOD PRESSURE VALUES AT VARIOUS AGES

Age in Years	Mean Systolic	Range in 95% of Normal Children	Age in Years	Mean Diastolic	Range in 95% of Normal Children
1/2 - 1 year	90	+ 25	1/2 - 1 year	61	+ 19
1 - 2 years	96	+ 27	1 - 2 years	65	+ 27
2 - 3 years	95	+ 24	2 - 3 years	61	+ 24
3 - 4 years	99	+ 23	3 - 4 years	65	+ 19
4 - 5 years	99	+ 21	4 - 5 years	65	+ 15
5 years	94	+ 14	5 years	55	+ 9
6 years	100	+ 15	6 years	56	+ 8
7 years	102	+ 15	7 years	56	+ 8
8 years	105	+ 16	8 years	57	+ 9
9 years	107	+ 16	9 years	57	+ 9
10 years	109	+ 16	10 years	58	+ 10
11 years	111	+ 17	11 years	59	+ 10
12 years	113	+ 18	12 years	59	+ 10
13 years	115	+ 19	13 years	60	+ 10
14 years	118	+ 19	14 years	61	+ 10
15 years	121	+ 19	15 years	61	+ 10

Data for 1/2-5 years from Allen-Williams, G. M.: Pulse-rate and blood pressure in infancy and early childhood.
Arch Dis Child, 20:125, 1945.

Data for 5-15 years from Graham, A. W.; Hines, E. A., Jr.; and Gage, R. P.: Blood pressure in children between the ages of five and sixteen years. *Amer J Dis Child*, 69:203, 1945.

RECOMMENDED DAILY DIETARY ALLOWANCES

RECOMMENDED DAILY DIETARY ALLOWANCES
FOOD AND NUTRITION BOARD, NATIONAL RESEARCH COUNCIL, REVISED 1968

	Age (yrs)	Wt. (kg)	Ht. (cm)	Calories	Protein (gm)	Calcium (gm)	Iron (mg)	Vit. A. (I.U.)	Thia- mine (mg)	Ribo- flavin (mg)	Niacin (mg)	Ascor- bic acid (mg)	Vit. D. (I.U.)
Infants	9-12	7	63	Kg x 115	Kg x 2.0	0.5	Kg x 1.0	2,500	0.4	0.1	6	35	400
	1-2	9	72	Kg x 100	1.8	0.6	15	1,500	0.5	0.6	8	35	400
Children	3-5	13	87	1,200	25	0.3	25	2,000	0.6	0.2	8	40	400
	6-9	18	107	1,500	30	0.8	10	2,500	0.8	0.8	11	40	400
	10-12	26	126	2,100	40	1.0	10	3,500	1.1	1.3	15	40	400
Boys	9-12	35	146	2,400	45	1.1	16	4,500	1.3	1.4	16	40	400
	13-14	43	151	2,700	50	1.4	18	5,000	1.4	1.4	18	45	400
	15-18	59	176	3,000	60	1.4	18	5,000	1.5	1.5	20	50	400
Girls	9-12	35	140	2,200	50	1.1	16	4,500	1.1	1.3	15	40	400
	13-14	44	154	2,300	50	1.3	18	5,000	1.2	1.5	15	45	400
	15-18	57	168	2,400	55	1.2	19	5,000	1.2	1.5	15	50	400

COMPOSITION OF FREQUENTLY USED FORMULAS

Formula	Calorie	Percentage (wt/vol)			mlq/l			mg/l			fat P ratio	actual fat to casein ratio
		Protein	Fat	CHO	Na	K	Ca	P	Fe			
Ala 3:11 gm	.67	3.3	2.0	7.0								
Ala 3:11 gm + 3% DM	.81	3.9	1.4	13.0	23	46	1436	630			2.1/1	
Ala 3:11 gm + 5% DM	.78	3.0	2.0	11.0								
Arden 3:1	.19	3.0										
3:24:11:1	.67	1.5	3.7	7.0	11	16.4	929	400	3.0		1.5/1	100
3:10:10:1	.33	3.5	0.5	5.0	57	36	1210	950	Trace		1.3/1	
Casein wt wt		88.0	2.0	0.0			1.6	0.8	0.0		2/1	
Case-free formula	1.34	3.6	7.0	0.04	30	44	1700	1260	16.0		1.3/1	
Glaxo's Milk	.67	3.5	3.5	4.8	22	38	1150	920	Trace		1.3/1	282
Infamil (1:13 cal.	.43	1.0	2.4	4.6	7	12	360	280	0.9		1.3/1	82
Infamil (1:24 cal.	.67	1.5	3.7	7.0	11	19	550	430	1.4		1.3/1	128
Infamil w. Fe 24 cal.	.80	1.8	4.5	8.5	13	22	660	516	14.4		1.2/1	152
Infamil 1:1	.69	3.5	4.0	5.0	26	40	1320	590	0.5		2.2/1	316
Infamil 2:3	.55	3.0	3.0	4.0	22	29	1060	470	Trace		2.2/1	
Infamil 1:1 + 5% DM	.75	3.0	3.0	8.8	22	29	1300	500	Trace		2.2/1	281
Geat's Milk Evap. 1:1	1.40	7.0	8.2	9.4			910	750	Trace		1.2/1	
Human Milk	.77	1.1	4.0	9.5	7	13	320	140	1.0		2.3/1	100
Isomil	.67	2.0	3.6	6.8	13	18	700	500	12.0		1.4/1	166
Isomilac (P)	.67	0.4	2.7	8.5	26	36	900	700	12.0		1.3/1	211
Isomilac (P)	.67	3.4	3.5	4.8	1	26	1100	1000	2.0		1.1/1	239
Isomilac	.30						80	40	0.0		2/1	315
Meat Base 1:1:15	.58	2.7	3.1	4.0	12	12	1960	1240	9.0		1.6/1	261
Nec Mat-Soy 1:1	.67	1.8	3.5	6.4	17	25	800	600	8.0		1.3/1	124

COMPOSITION OF FREQUENTLY USED FORMULAS

FORMULA	Cal/cc	Percentage wt/vol			mlq/l.			mq/L			Ca/P ratio	Renal Sol- ute Load mOsm/L
		Protein	Fat	CHO	Na	K		Ca	P	Fe		
Nutramigen (P) 1:5	.67	2.2	2.6	8.6	18	27		900	625	12	1.4/1	195
Nutramigen + 5% DM	.90	2.2	2.2	14.0	18	27						
Pedialyte	.20	9.0	5.0	5.0	30	20		160	0	0		287
Peptagen wt/wt (per gm)	47/gm	18.0	22.0	33.0	268	870		660	540	80	1.2/1	
Peptagen 1:7	.67	2.5	3.1	7.3	16.1	30.8		1800	1500	10	1.2/1	360
Progestimil	.67	2.2	2.8	8.3	18	27		900	700	12	1.3/1	194
Probase (P)	.67	4.2	2.2	7.9	27	32		950	850	2.8	1.1/1	310
Probase 1:1	.67	2.5	3.4	6.8	23	27		900	650	12	1.4/1	200
Premature Form. 24	.80	2.8	3.7	9.1	20	32		940	750	0.4	1.3/1	235
Similac 13 cal.	.43	1.2	2.4	4.5	10	15		430	338	Trace	1.3/1	104
Similac 2% cal.	.67	1.8	3.5	7.0	12	22		660	520	Trace	1.3/1	156
Similac wt/Fe 24 cal.	.80	2.2	43.0	8.4	15	27		800	624	15	1.3/1	189
Similac PM 50/40	.67	1.5	3.4	7.2	7	14		350	180	2.0	2/1	119
Similac Advance	.55	3.6	1.5	5.5	17			1000	800	18	1.2/1	
Similac Milk	.36	3.6	0.1	5.1	22.6	37.2		2424	2500	Trace	1/1	295
Similac Improved 1:1	.67	1.5	3.6	7.2	7	14		420	312	12	1.3/1	117
Similac P 1:10	.33	3.3	0.95	4.8	25	35		1240	550		2.2/1	
Similac (1) 1:1	1.80	11.0	1.6	31.0	41	92		3200	268		2.2/1	1080

L = Liquid

P = Powder

DM = Dextro-Maltose

PROTEIN, FAT, AND CARBOHYDRATE COMPOSITIONS OF VARIOUS FORMULAS			
FORMULA	PROTEIN	FAT	CHO
Baker's Modif.	Skim Milk	Corn, Soy, Coconut	D, M, L, DNS
Brenil	Skim Milk	Soy, Coconut	S, L
Casec	Ca Caseinate	Butter Fat	-
CHO Free	Soy	Soy	-
Cow's Milk	Cow's Milk	Butter Fat	L
Enfamyl	Skim Milk	Corn, Soy, Coconut	L
Goat's Milk	Goat's Milk	Animal Fat	L
Human Milk	Human Milk	Human Milk Fat	L
Isomil	Soy, Methionine	Corn, Coconut	S, D, M, DNS, CS
Lactenolac	Casein Hydrolysate	Corn	S, M, DNS, TS
Lonalac	Casein	Coconut	L
Lytren	-	-	D
Meat Base	Beef	Animal Fat, Sesame Oil	S

FORMULA	PROTEIN	FAT	CHO
Neo-Mull-soy	Soy, Methionine	Soy	S
Nutramigen	Casein Hydrolysate	Corn	S, TS
Pedialyte	-	-	D
Portagen	Casein	M.C.T., Corn	D, M, S, L (0.15%)
Pregestimil	Casein Hydrolysate	M.C.T., Corn	D, TS
Preparation Form. 24	Skim Milk	Corn	L, S
Probona	Cow's Milk & Casein	Butter Fat	L, D, Banana Powder
Prosoy	Soy, Methionine	Soy	S, D, M, DNS
Similac	Skim Milk	Corn, Coconut	L
SMA Improved	Skim Milk, Whey	Soy, Coconut, Oleo High Oleic	L

D = dextrose

M = maltose

S = sucrose

L = lactose

DNS = Dextrins

TS = Tapioca Starch

CS = Corn Starch

MCT = Medium Chain Triglycerides

COMPARISON OF HUMAN MILK WITH COW'S MILK

COMPARISON OF HUMAN MILK WITH COW'S MILK (WHOLE AND EVAPORATED)

	Human Milk %		Cow's Milk	
	Whole %	Evaporated %	Whole %	Evaporated %
Water	87.0-88.0		83.0-88.0	73.0-74.0
Proteins	1.0-1.5		3.2-4.1	6.8-7.0
Lactalbumin	0.7-0.8		0.5	1.1
Casein	0.4-0.5		3.0	5.7
Sugar (Lactose)	6.0-7.5		4.5-5.0	9.8-10.0
Fat	3.0-4.0		3.5-5.2	7.9-8.2
(More olein and less of the volatile fatty acids)				
Minerals	0.15-0.25		0.7-0.75	1.5-1.6
Calcium	0.034-0.045		0.122-0.179	
Phosphorus	0.015-0.040		0.090-0.196	
Magnesium	0.005-0.006		0.013-0.019	
Sodium	0.011-0.019		0.051-0.060	
Potassium	0.048-0.065		0.138-0.172	
Chlorine	0.035-0.043		0.098-0.116	
Sulphur	0.0035-0.0037		0.030-0.032	
Iron	0.0001		0.00004	
Copper	0.00003		0.00002	
Vitamins (per 100 cc.):				
A	60-500 I. U.		80-220 I. U.*	No loss
B	0.4-10.0 I. U.		0.3-4.1 I. U.*	No loss
C	1.2-10.8 mg.		0.9-1.4 mg.*	0.6 mg.+

(continued on next page)

COMPARISON OF HUMAN MILK WITH COW'S MILK
(continued)

	Cow's Milk		
	Human Milk %	Whole %	Evaporated %
Thiamine	0.002-0.036 mg.	0.03-0.04 mg. *	0.02-0.03 mg. +
Riboflavin	0.015-0.080 mg.	0.010-0.20 mg. *	No loss
Niacin	0.10 mg.-0.20 mg.	0.10 mg.	Acid or amphoteric
Digestion	Alkaline or amphoteric	Acid or amphoteric	None
Bacteria	None	Present	
Digestion		Less rapidly	
Emptying of stomach		Less rapidly	
Calories	Soft, flocculent	Hard, large	Soft, Flocculent
Calories per fluid ounce	20	20	44

* Values are for pasteurized milk.

Values are from Nelson - Textbook of Pediatrics, 1959.

BLOOD CHEMISTRIES

*Alkaline phosphatase:

[1 King-Armstrong unit = 7.08 milli-International Unit (m-I.U.)]

Birth	35-105 m-I.U./ml
1 month-1 year	70-250 m-I.U./ml
1-3 years	70-210 m-I.U./ml
3-10 years	70-180 m-I.U./ml
10-16 years	100-275 m-I.U./ml

*Acid phosphatase (total):

[1 King-Armstrong unit = 1.77 milli-International Unit (m.I.U.)]

Birth	3-6 m-I.U./ml
1 month-1 year	6.5-11 m-I.U./ml
1-3 years	6.5-11 m-I.U./ml
3-10 years	3.5-9 m-I.U./ml
10-16 years	3-10 m-I.U./ml

*Amylase, serum:

less than 160 caraway units/100 ml

Ascorbic acid:

over 0.3 mg%

*Bicarbonate (CO₂ capacity or combining power):

22-30 mEq/L

*Bilirubin:

Cord:	up to 1.8 mg%
2-4 days:	mean peak 7 mg%, range 2-12 mg%
After newborn period:	less than 0.8 mg% total

*Bromsulfalein Retention:
(at 45 minutes)

Newborn:	up to 20%
Thereafter:	less than 5%

*Calcium:

9.0-11.5 mg%

Carotene:

Newborn:	25 micrograms %
Thereafter:	60-180 micrograms %

*Cephalin Flocculation:

Infants:	erratic
Thereafter:	0-1+ (3+ is max. at JHH)

*Chloride:

94-106 mEq/L

*Cholesterol:

150-275 mg%, 65-76% esterified

Copper:

1 month:	50-100 micrograms %
1 year:	110-175 micrograms %
5-17 years:	80-280 micrograms %
Adult:	80-180 micrograms %

*Creatinine: 0.7-1.5 mg%

*Fibrinogen, plasma: 200-400 mg/ml

*Glucose (fasting): 55-100 mg%

Iodine, Protein Bound:

Newborn:	6-10.7 micrograms %
1 week:	9-14 micrograms %
1-12 weeks:	5.6-9.2 micrograms %
3-12 months:	5.3-7.3 micrograms %
Thereafter:	3.5-8.0 micrograms %

Butanol extractable iodine averages 0.5 micrograms lower.

Iron:

	Mean Serum Fe	Total Fe Binding Capacity	Percent Saturation
1 week:	148 micro- gm%	262 micro- gm%	65
3 months:	50	350	15
6-12 months:	106	429	25
1-2 years:	95	414	22
2-6 years:	116	395	28
6-12 years:	127	340	38

Ketones: up to 3 mg%

Lactic Acid (fasting): up to 10 mg% if precipitated STAT, otherwise, up to 20 mg%

Lactic Dehydrogenase: 0-300 m-I.U./ml

Lead: under 0.04 mg%

*Lipids:

Total:	400-900 mg%
Phospholipids:	mean 225 mg% (usually slightly higher than cholesterol)

*Magnesium: 1.9-2.3 mEq/L (av. 2.0)

Mucoproteins:
(as tyrosine): 1.9-4.5 mg%

pH (arterial whole blood: 7.35-7.45 (0.03 lower in venous blood)

PCO₂ (arterial): 35-45 mmHg

PO₂ (arterial): 85-100 mgHg

*Phosphorus, inorganic:

1st year: 4-7 mg%

1-12 years: 5-6 mg%

Adult: 3-4 mg%

*Porcelain: 8-20 mEq/L

*Potassium:

0-10 days: up to 7 mEq/L

Thereafter: 3.2-6.0 mEq/L

*Proteins:

Total: 6-8 gm%

Albumin: 4.7-5.7 gm%

Globulin: 1.3-2.5 gm%

Proteins: Average (Range) in Grams

Age	Total	Albumin	Globulin	Gamma Globulin
Premature	5.5 (4.6)	3.7 (2.5-4.5)	1.8 (1.2-2)	0.7 (0.5-0.9)
FT Newborn	6.4 (5-7.1)	3.4 (2.5-5)	3.1 (1.2-4)	0.8 (0.7-0.9)
1-3 months	6.6 (4.7-7.4)	3.8 (3-4.2)	2.5 (1-3.3)	0.3 (0.1-0.5)
3-12 months	6.8 (5-7.5)	3.9 (2.7-5)	2.6 (2-3.8)	0.6 (0.4-1.2)
1-15 years	7.4 (6.5-8.6)	4.0 (3.2-5)	3.1 (2-4.4)	0.9 (0.6-1.2)

*Sodium: 134-151 mEq/L

*Thymol Turbidity: 0-5 units

Tocopherol (Vitamin E):

Premature: 0.05-0.35 mg%

FT newborn: 0.1-0.35 mg%

2-5 months: 0.2-0.6 mg%

6-24 months: 0.35-0.8 mg%

2-12 years: 0.55-0.9 mg%

Adult and breast-fed babies: 0.6-1.1 mg%

*Transaminases: SGOT SGPT

1st week: 10-120 u 10-90 u

Thereafter: 5-45 u 5-45 u

*Urea Nitrogen: 5-20 mg%

Non-protein nitrogen: 22-40 mg%

* <u>Uric Acid:</u>	2-6 mg%
<u>Vitamin A:</u>	over 40 micrograms %
<u>Zinc Turbidity:</u>	
Newborn:	less than 10
1-8 months:	less than 3
9-12 months:	less than 5
Thereafter:	less than 8

*These determinations are done by The Johns Hopkins Hospital routine laboratory on serum, and the values quoted apply to their methods. Values for other determinations are taken from the literature and may not be valid for a given laboratory.

S E R O L O G Y

Below are the tests that the JHH lab routinely performs. If a desired test is not mentioned below, the lab will send the blood to an appropriate lab elsewhere.

Normal Values:

ASO	-	< 50
Anti-hyaluronidase	-	< 1:200
CRP	-	Negative.
Heterophile	-	1/80. A serum 80 is absorbed following which 1/80 is still borderline.
Rose Test	-	Titer with sensitized cells should be less than 5 times the titer with washed cells.
Rubella	-	HAI titer.
STS	-	Negative.
Typhoid O, H.	-	< 1/80.
Paratyphoid A & B	-	< 1/80.

All Complement Fixations Should Be Negative:

Brucellosis
 Cytomegalic Inclusion Disease
 Eastern and Western Equine Encephalitis
 Epidemic Typhus
 Influenza Type A (F.M.I. & P.R. 8)
 Influenza Type B (Lee)
 Lymphocytic Choriomeningitis
 Lymphogranuloma Venereum
 Mumps
 Psittacosis
 Q Fever (American)
 Rickettsial Pox
 Rocky Mountain Spotted Fever
 St. Louis Encephalitis
 Toxoplasmosis
 Tularemia

CEREBROSPINAL FLUID

Amount (obtainable by LP):

Newborn: up to 5 ml
 Adult: 100-150 ml

Initial pressure:

Newborn: 50-90 mm CSF
 Infant: 40-150 mm
 Child: 70-200 mm

Specific Gravity: 1.005-1.009

pH at 38°C: 7.33-7.42

Calcium: 4.5-5.5 mg% (approximates ionized serum Ca)

Cell count:

Newborn: up to 25 WBC (av. 8) and
 up to 650 RBC/mm³
 After 1st month: up to 7 lymphocytes

Glucose: 40-80 mg% (at least 1/2 of blood sugar)

Pandy (mainly globulin): 0 (may be positive in newborn)

Protein (80% albumin):

Ventricular: 5-15 mg%
 Cisternal: 5-25 mg%
 Lumbar: 5-40 mg%
 up to 150 mg% in newborn*

G-0 Transaminase: 4-14 units, often about 1/2 of SGOT

*There is too little data available on newborn CSF to define normal limits or to allow find diagnostic distinctions.

Ref: Wyers, H.J.G., and Bakker, J.C.W.: Neederland Tijdschrift voor Kindergeneeskunde. 22:253, 1954.

IMMUNOGLOBIN LEVELS AT DIFFERENT AGES

AGE	IgG ($\pm$ 2 SD range)	IgA ($\pm$ 2 SD range)	IgM ($\pm$ 2 SD range)	
			Male	Female
			11 (0-23)	
Cord Blood	100-110% Maternal Level	0		
2- 4 mo	362 (142- 930)	17 (5- 64)	44 (14-142)	44 (16-125)
5- 8 mo	433 (250-1190)	34 (10- 87)	62 (24-167)	59 (50-163)
9-14 mo	633 (322-1245)	40 (17- 94)	80 (30-212)	79 (29-216)
15-23 mo	863 (466-1600)	63 (22-178)	81 (35-189)	100 (44-240)
2- 3 yr	808 (400-1620)	71 (27-192)	83 (41-168)	81 (33-196)
3 1/2-4 1/2 yr	963 (615-1530)	100 (42-238)	92 (31-272)	126 (37-425)
5- 6 yr	976 (625-1530)	121 (44-334)	86 (38-197)	86 (30-248)

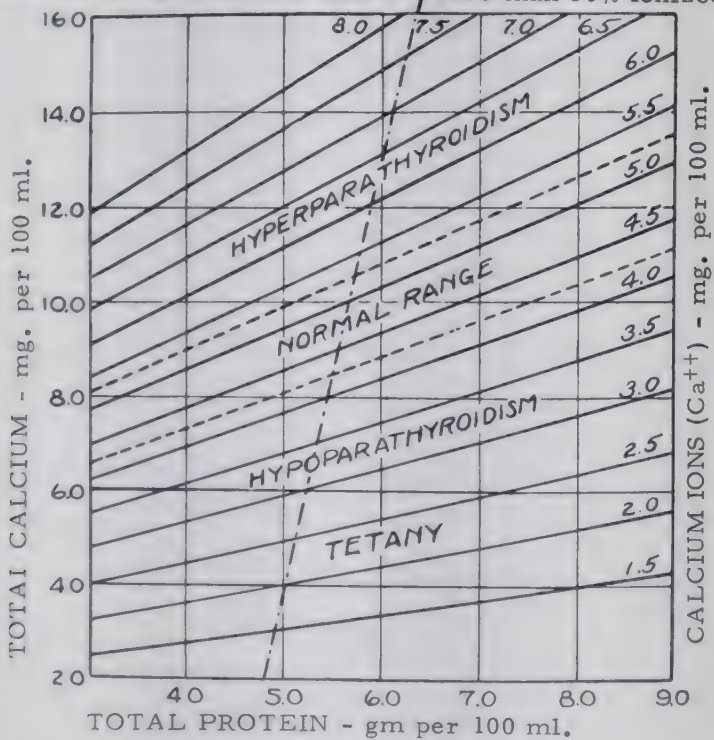
IMMUNOGLOBULIN LEVELS AT DIFFERENT AGES (continued)

AGE	IgG ($\pm$ 2 SD range)	IgA ($\pm$ 2 SD range)	IgM ($\pm$ 2 SD range)	
			Male	Female
7- 8 yr	1010 (615-1655)	102 (42-288)	73 (24-225)	100 (35-282)
9-10 yr	1090 (766-1560)	142 (43-435)	85 (35-208)	123 (43-348)
11-12 yr	1095 (727-1650)	150 (44-508)	73 (22-237)	111 (41-272)
13-14 yr	1090 (840-1390)	172 (59-505)	82 (37-183)	107 (58-196)
15-16 yr	1160 (879-1540)	170 (61-420)	93 (38-223)	142 (75-271)
17-18 yr	1070 (686-1680)	183 (80-419)	86 (26-281)	145 (45-463)
19-21 yr	964 (655-1420)	155 (47-508)	84 (37-191)	123 (49-308)
Adult	1044 (710-1540)	174 (60-490)	87 (37-204)	104 (42-261)

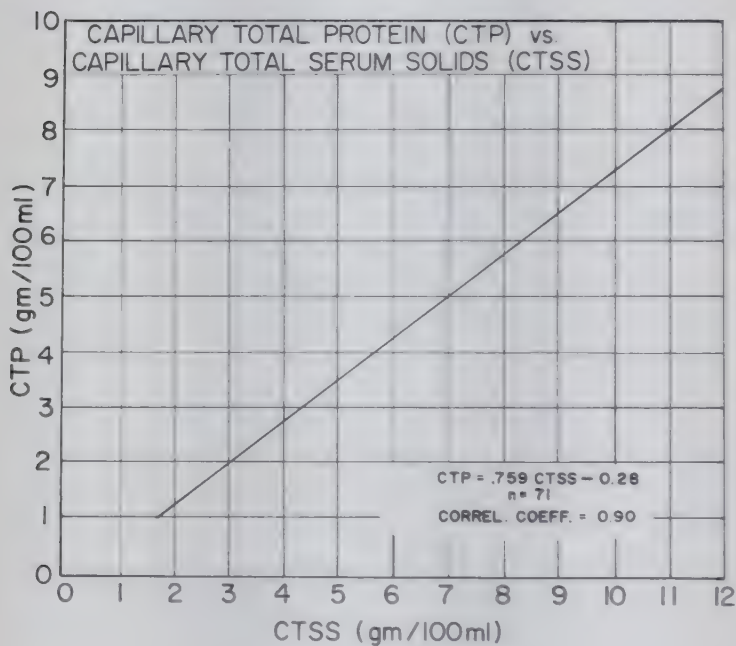
Adapted from: J. Peds. 72:276, 1968 and Ped. Clin. N. A. 18:104, 1971

MCLEAN, HASTINGS NOMOGRAM

Calcium more than 50% ionized / less than 50% ionized



TOTAL SERUM PROTEINS VS. TOTAL SERUM SOLIDS



RED CELL VALUES DURING GESTATION

Weeks gestation	Hemoglobin Gm%	Hematocrit	RBC $10^6/\text{mm}^3$	MCV 3	MCH $\text{Gm} \times 10^{-12}$	MCHC %	NRBC % Total	Retic %
12	8.0-10.0	33	1.5	180	60	34	5.0-8.0	40
16	10.0	35	2.0	140	45	33	2.0-4.0	10-25
20	11.0	37	2.5	135	44	33	1.0	10-20
24	14.0	40	3.5	123	38	31	1.0	5-10
28	14.5	45	4.0	120	40	31	0.5	5-10
34	15.0	47	4.4	118	38	32	0.2	3-10

HEMATOLOGY

	Gm. Hgb.	% Hct.	WBC/mm ³	% Polys	% Retics
1 day	16-22*	53-73*	18,000 (7-35,000)	45-85	2.5-6.5
1 week	13-20*	43-66*	10,000 (4-20,000)	30-50	0.1-4.5
1 month	16	53	10,000 (6-18,000)	30-50	0.1-1.0
3 months	11.5	38	10,000 (6-17,000)	30-50	0.7-3.0
6 months	12	40	10,000 (6-16,000)	30-50	0.7-2.3
1 year	12	40	10,000 (6-15,000)	30-50	0.6-1.7
2-6 years	13	43	9,000 (7-13,000)	35-55	0.5-1.0
7-12 years	14	46	8,500 (5-12,000)	40-60	0.5-1.0

Absolute eosinophil count: 100-600/mm³, average 250

*Under the age of 1 month capillary Hgb and Hct exceed venous:

1 hour:	3.6 gm av. difference
5 days:	2.2 gm av. difference
3 weeks:	1.1 gm av. difference

AVERAGE NORMAL BONE MARROW VALUES

<u>WBC</u>	<u>Normal % and Range</u>
"Blasts"	2.0 (0.3-5.8)
Undiff. myelocytes (A & B)	5.0 (1.0-8.0)
Diff. myel. (0)-neuro.	12.0 (5.0-19.0)
" " " -eosino.	1.5 (0.5-3.0)
" " " -baso.	0.3 (0-0.5)
Metamyelocytes - neutro.	22.0 (13.0-32.0)
" - eosino.	
P.M.N. neutrophils	20.0 (7.0-30.0)
" eosinophils	2.0 (0.5-4.0)
basophils	0.2 (0-0.7)
Monocytes	2.0 (0.5-5.0)
Lymphocytes	10.0 (3.0-17.0)
Plasma Cells	0.4 (0-2.0)
Reticulum cells & macrophages	0.2 (0.2-2.0)
Mitotic figures	
Unclassified cells	

<u>RBC</u>	
Megaloblasts	0
Pronormoblasts	4.0 (1.0-8.0)
Basophilic normoblasts)	
Polychromatophilic norm.)	18.0 (7.0-32.0)
Orthochromatic norm.)	

CONVERSION FORMULAS

Weight

<u>Grams</u>	<u>Pounds</u>
454	1.0
1000	2.2

To change pounds to grams, multiply by 454.

To change kilograms to pounds, multiply by 2.2.

Length

To convert inches to cms, multiply by 2.54.

Temperature

To convert centigrade to Fahrenheit:

$$(9/5 \times \text{temperature}) + 32$$

To convert Fahrenheit to centigrade:

$$(\text{Temperature} - 32) \times 5/9$$

TEMPERATURE EQUIVALENTS

Centigrade	Fahrenheit	Centigrade	Fahrenheit
34.0	93.2	38.6	101.4
34.2	93.6	38.8	101.8
34.4	93.9	39.0	102.2
34.6	94.3	39.2	102.5
34.8	94.6	39.4	102.9
35.0	95.0	39.6	103.2
35.2	95.4	39.8	103.6
35.4	95.7	40.0	104.0
35.6	96.1	40.2	104.3
35.8	96.4	40.4	104.7
36.0	96.8	40.6	105.1
36.2	97.1	40.8	105.4
36.4	97.5	41.0	105.8
36.6	97.8	41.2	106.1
36.8	98.2	41.4	106.5
37.0	98.6	41.6	106.8
37.2	98.9	41.8	107.2
37.4	99.3	42.0	107.6
37.6	99.6	42.2	108.0
37.8	100.0	42.4	108.3
38.0	100.4	42.6	108.7
38.2	100.7	42.8	109.0
38.4	101.1	43.0	109.4

CONVERSION OF POUNDS AND OUNCES TO GRAMS

CONVERSION OF POUNDS AND OUNCES TO GRAMS

Ounces	1 lb.	2 lb.	3 lb.	4 lb.	5 lb.	6 lb.	7 lb.	8 lb.
	GRAMS							
0	454	907	1,361	1,814	2,268	2,722	3,175	3,629
1	482	936	1,389	1,843	2,296	2,750	3,204	3,657
2	510	964	1,418	1,871	2,325	2,778	3,232	3,686
3	539	992	1,446	1,899	2,353	2,807	3,260	3,714
4	567	1,021	1,474	1,928	2,381	2,835	3,289	3,742
5	595	1,049	1,503	1,956	2,410	2,863	3,317	3,771
6	624	1,077	1,531	1,985	2,438	2,892	3,345	3,799
7	652	1,106	1,559	2,013	2,466	2,920	3,374	3,827
8	680	1,134	1,588	2,041	2,495	2,948	3,402	3,856
9	709	1,162	1,616	2,070	2,523	2,977	3,430	3,884
10	737	1,191	1,644	2,098	2,552	3,005	3,459	3,912
11	765	1,219	1,673	2,126	2,580	3,033	3,487	3,941
12	794	1,247	1,701	2,155	2,608	3,062	3,515	3,969
13	822	1,276	1,729	2,183	2,637	3,090	3,544	3,997
14	851	1,304	1,758	2,211	2,665	3,119	3,572	4,026
15	879	1,332	1,786	2,240	2,693	3,147	3,600	4,054

I N D E X

- Acetone, urine tests for, 20
- Acid-Base disturbances, 186
- Acid fast stain, 35
- Acidosis, blood gases in, 186
- ACTH tests, 77
- Active immunization, 191, 192-197
- Addis count, 27
- Adrenal capacity, tests for, 77
 - ACTH tests, 77
 - SU-4885, 78
- Adrenal glucocorticoids, 156
- Adrenal mineralocorticoids, 158
- Age-size table, parent specific, 222
- Albumin, urine test for, 18
- Alkalosis, blood gases in, 186
- Anemia, hematologic indices, 13
- Anesthesia, pre-operative medication, 159
- Anti-arrhythmia drugs, 160-161
- Antibiotic doses in uremia, 162-163
- Apt test for fetal hemoglobin, 39
- Arginine-insulin tolerance test, 73-75
- Arrhythmias, drugs for control of, 160-161
- Arthritis, synovial fluid valves, 34
- Aspirin ingestion, 176-178
- Atomic weights, 167

- Bacteriology, culture methods, 35
 - Staining techniques, 35
- Barium enema, regular, 94
 - Air contrast, 93
- Basal caloric requirements, 169
- BCG vaccine, 196
- Beth, 1971
- Bilirubin, in urine, 23
- Bleeding, tests for abnormal, 14
- Bleeding time (Ivy's method), 14
- Blood chemistries, normal values, 237-240
- Blood culture techniques, 35
- Blood gases, normal values, 186
- Blood pressure, normal values, 228, 229
- Body surface area nomogram, 223
- Bone age, 85, 224
- Bone marrow aspiration, 4
 - Normal values, 249
 - Smear technique, 5
- Bromsulphalein test, 55
- Bronchopulmonary segments, 188
- Buccal smear, 71
- Bundle branch block, 66
- Burn management, cutaneous, 180-182
 - lye, 182
- Butterfat absorption test, 55

- Calcium,
 - Ca/P ratio and content of formulas, 231-232
 - McLean Hastings nomogram, 245
 - Parathyroid function, 84
 - Recommended dietary allowances, 230
- Calories,
 - Basal requirements, 169
 - Content in various formulas, 231-232
 - Recommended daily allowances, 230
- Capillary blood sampling, 3
- Carbohydrate composition of various formulas, 231-232
- Cardiology, 56-69
 - Cardiac cycle, 58
 - Circulation time, 56
 - Electrocardiography, 57-67
 - Intracardiac pressures, 69
 - X-ray contour of heart, 68
- Catecholamines, urinary, 83
- Cat scratch disease, skin test, 97
- Centigrade conversion to fahrenheit, 250
- Cerebrospinal fluid, culture technique, 31
 - Examination of, 30
 - Normal values, 242
- Chancroid skin test, 97
- Charcoal, substances absorbed by, 175
- Chemistries, normal values, 237-240
- Chest measurements by age, 209-211
- Chest physiotherapy, 183
- Cholecystogram, 95
- Circulation time, 56
- Clot lysis, 15
- Clot retraction, 14
- Clotting time (Lee-White), 14
- Coccidioidin skin test, 97
- Cold agglutinin test, 101
- Concentration and dilution test, 26
- Congenital anomalies,
 - dermatoglyphic patterns in, 96
- Contagious diseases,
 - Incubation periods, 200-201
 - Isolation periods, 200-201
- Conversion factors for electrolytes, 168
- Conversion formulas, 250-251
 - Centigrade - fahrenheit, 250
 - Centimeters - inches, 250
 - Grams - ounces, 251
- Coproporphyrin, urine test for, 49
- Creatinine clearance test, 25
- Creatinine tolerance test, 45
- Crystals, urinary, 21
- Culture methods, 35
- Cutdown, venous, 8
- Cystic fibrosis,
 - Stool gelatinase activity, 39
 - Stool TCA test, 39
 - Sweat test, 100

- Cystourethrogram, 95
- Cytomegalic inclusion disease,
 - Urine test for, 22
 - Serologic test for, 241
- Decadron suppression test, 79
- Decholin circulation time, 56
- Dehydration, deficit therapy of, 171
- Dental eruption, times,
 - Primary teeth, 226
 - Secondary teeth, 227
- Denver developmental screening test, 91
- Developmental evaluation, 88-92
- Diabetes mellitus,
 - Insulin, 154-155
 - Fluid and electrolyte therapy, 171
- Dietary allowances, daily, 230
- Diet, ketogenic, 204
- Digitalis,
 - Electrocardiographic changes, 66
 - Poisoning, 179
 - Preparations, 152-153
- Dilution and concentration test, 26
- Diphtheria,
 - Immunization, 191, 192
 - Incubation period, 200
 - Skin test for, 98
- Disaccharide tolerance tests, 52
- Drugs,
 - Anti-arrhythmia, 160-161
 - Antibiotics in uremia, 162-163
 - Doses of, 109-158
 - Index, 105-108
 - Preoperative medications, 159
 - Primaquine sensitivity, 164
- D-xylose test, 53
- Echinococcus skin test, 97
- Einthoven triangle, 61
- Electrocardiography, 57-67
 - Bundle branch block, 66
 - Digitalis effect and toxicity, 66
 - Electrolyte disturbances, 66-67
 - Heart rate, 59
 - Lead placement, 59
 - Normal R and S wave values, 65
 - Overload pattern, 65
 - P-waves, 60
 - PR interval, 60
 - QRS axis at various ages, 62
 - QRS axis calculation, 61
 - QRS complex, 62
 - QT interval, 62
 - QT interval correction, 63
 - Rhythm, 59
 - T wave, 64
 - Ventricular hypertrophy, 64
- Electrolyte,
 - Content of fluids, 173-174

Electrolyte (cont.)

Content of formulas, 231-232

Maintenance requirements, 170

Ellsworth-Howard test, 84

Endocrinology, 70-87

ACTH tests, 77

Adrenal capacity, 77

Arginine-insulin tolerance test, 73-75

Bone age, 85

Buccal smear, 71

Decadron suppression test, 79

Diagnostic methods, table, 86-87

Ellsworth-Howard test, 84

Estrogen and gonadotropins, 72

Growth hormone, 73-75

Hypertonic salt test, 81

Insulin tolerance test, 73-75

Parathyroid function tests, 84

Pitressin test, 81

Pheochromocytoma, 82-83

Pituitary suppression tests, 79

Salt deprivation test, 80

17-hydroxysteroids, 75

17-ketosteroids, 75

Steroid assay methods, 75-80

SU-4885 test, 78

Thyroid tests, 70-71

Vaginal smear, 72

VMA, 83

Water load test, 80

Eosinophil count, 12

Epinephrine tolerance test, 42

Erythrocytes,

Counting technique, 11

Normal values during gestation, 247

Osmotic fragility test, 16

Sedimentation rate, 15

Exchange transfusion, 9-11

Excretory urogram, 94

Fahrenheit to centigrade conversion, 250

Farber meconium test, 39

Fat,

Butterfat absorption test, 55

Content in various formulas, 231-232

Stool test for, 40, 54

Fecal fat test, 40, 54

Femoral venapuncture, 3

Ferric chloride reaction, 46

Fetal hemoglobin test (Apt test), 39

Fluid and Electrolytes, 167-174

Burn therapy, 180

Composition of fluids, 173-174

Conversion factors, 168

Deficit therapy, 171

Deficits in various conditions, 171

Diabetes, 171

External losses, 172

- Fluid and Electrolytes (cont.)
 - Maintenance requirements, 169-170
 - Maintenance solution, 170
- Fluorescein circulation time, 56
- Formulas, composition, 231-232
- Fragility test, erythrocyte, 16
- Frei test, 97
- Fructose tolerance test, 43
- Fungus, examination for, 36
- G-6-P-D deficiency, drugs to be avoided in, 164
- Galactose tolerance tests, 43
- Gamma globulin, indications, 197-199
- Gastrointestinal tract, 51-55
 - Bromsulphalein test, 55
 - D-xylose test, 53
 - Fat absorption test, 55
 - Histamine test, 51
 - Mono and disaccharide intolerance, 52
 - Pancreatic trypsin, 51
 - Stool fat content, 54
 - Stool gelatinase activity, 39
- GI series, 93
- Glucagon tolerance test, 43
- Glucose determination, 46
- Glucose tolerance tests, 42
- Gonadotropins, 72
- Goodenough-Harris draw-a-person test, 88-90
- Gram stain, 35
- Growth charts,
 - Boys, 214, 215, 217
 - Girls, 212, 213, 216
 - Intrauterine, 218, 219
 - Premature, 220, 221
 - Parent-Specific Age-size Table, 222
- Guaiac test, 37
- Harrison spot test, 23
- Head circumference charts,
 - Boys, 217
 - Girls, 216
 - Intrauterine, 219
 - Prematures, 221
- Heart (see Cardiology)
- Height, normal values, 209-211
- Hematology, 11-17
 - Bleeding time, 14
 - Clot lysis, 15
 - Clot retraction, 14
 - Clotting time, 14
 - Eosinophil count, 12
 - Erythrocyte count, 11
 - Hemoglobin, 11
 - Indices, 13
 - Leukocyte count, 11
 - Normal values with age, 248
 - Osmotic fragility, 16

Hematology (cont.)

- Platelet count, 12
- Reticulocyte count, 13
- Sedimentation rate, 15
- Tourniquet test, 15
- Wright's stain, 13

Hemoglobin,

- Estimation, 11
- In urine, 23
- Normal values, 247, 248

Hemosiderin in urine, 25

Hemolytic anemia, sensitizing drugs, 164

Hepatitis immunization, 197

Heterophile, normal values, 241

Histamine stimulation test, 51

Histoplasmin skin test, 97

Homovanillic acid (HVA), 83

Human milk,

- Comparison with cow's, 235
- Composition, 235

Hypertonic salt test (Hickey-Hare), 81

Immunization, active, 191, 192-197

- DPT, 192
- For foreign travel
- Influenza, 195
- Measles, 193
- Mumps, 195
- Polio, 193
- Rabies, 195
- Rocky mountain spotted fever, 196
- Rubella, 196
- Schedule of, 191
- Smallpox, 194
- Tuberculosis, 196
- Typhoid, 197

Immunization, passive, 197-199

- Hepatitis, 197
- Measles, 197
- Pertussis, 197
- Rubella, 198
- Tetanus, 198

Immunoglobulin levels at various ages, 243

Incubation periods for contagious diseases,
200-201

India ink stain, 32, 35

Indicanuria, test for, 45

Infectious hepatitis immunization, 197

Influenza vaccine, 195

Insulin preparations, 154

Intrauterine growth,

- Head circumference, 219
- Length, 218, 219
- Weight, 218, 219

Iron, content in various formulas, 231-232

- Doses and preparations, 124
- Poisoning, 178
- Recommended dietary allowances, 230

- Isolation periods for contagious diseases, 200-201
- Isolation techniques, 202-203
- IVP, 94
- Jugular venapuncture,
 - External, 3
 - Internal, 4
- Ketogenic diet, 204-205
- Ketosteroids, 76
- Kveim test, for sarcoidosis, 98
- Lead intoxication, 179
- Lee-White clotting time, 14
- Length conversion, 250
- Leucine tolerance test, 44
- Leukocyte count, 11
- Liver function, BSP, 55
- Lumbar puncture, 30
- Lung, bronchopulmonary segments, 188
- Lung volumes, 189, 190
- Lupus preparation, 101
- Lye burns, 182
- Lymphogranuloma venereum, skin test, 97
- Marrow, 4
- McLean-Hastings nomogram, 245
- MCH, 13
- MCHC, 14
- MCV, 13
- Measles,
 - Active immunization, 193
 - Incubation period, 200
 - Passive immunization, 197
- Meconium,
 - Farber test, 39
 - TCA test, 39
- Medications (see Drug Doses)
- Metaprione test (SU-4885), 78
- Microbiological exams, 35
- Milk,
 - Carbohydrate content for various formulas, 231-232
 - Comparison of human and cow, 235
 - Comparison of various formulas, 231-232
 - Fat sources for various formulas, 231-232
 - Protein sources for various formulas, 231-232
- Milliequivalent conversion factors, 168
- Moloney skin test (Diphtheria toxoid), 98
- Monosaccharide absorption test, 52
- Mucopolysaccharides, urine test, 48
- Mucoviscidosis, sweat test for, 100
 - Stool gelatinase activity, 39
 - Stool TCA test, 39
- Mumps,
 - Immunization, 195
 - Incubation period, 200
 - Skin test, 98
- Myoglobinuria, 23

- Nasal smear for eosinophils, 102
- Nasotracheal tube length estimation, 184
- Normal measurements, 209-221
- Nutrition, 230-236
- Orthostatic albuminuria, 27
- Osmolality and osmolarity, 168
- Osmotic fragility, 16
- Ossification centers, development, 85, 224
- Ounces, conversion to grams, 251
- Pancreatic trypsin, in duodenal juice, 51
- Pandy test, 30
- Paracentesis, 6
- Parasitology, stool tests, 37
- Parathyroid function studies, 84
 - Calcium and phosphorus levels, 84
 - Ellsworth-Howard test, 84
 - Renal phosphate clearance, 84
- Parent Specific-age-size tables, 222
- Parenteral fluids, composition, 174
- Passive immunization (see Immunization)
- Pelvic pneumography, 95
- Pertussis,
 - Immunization, 191, 192
 - Incubation period, 201
- pH, Abnormal values, 186
 - CSF, 242
 - Normal values, 186
- Phenothiazine drugs, urine test for, 46, 47
- Phenylalanine tolerance test, 45
- Phenylketonuria, test for, 46, 47
- Pheochromocytoma, tests for, 82-83
- Pinworms, examination for, 37
- Pitressin test, 81
- Pituitary suppression test, 79
- Plasma corticoids (cortisol) assay, 77
- Platelet count, 12
- Poisoning, 175-179
 - Digitalis, 178
 - Iron, 178
 - Lead, 178
 - Lye, 182
 - Potassium, 178
 - Salicylates, 176-178
 - Substances absorbed by charcoal, 175
- Polio,
 - Immunization, 193
 - Incubation period, 200
- Potassium intoxication, 178
- Porphyria test, 49
- Pounds, conversion to grams, 251
- Premature growth chart, 220, 221
- Preoperative medication, 159
- Primaquine sensitivity, drugs to avoid, 164

Protein,

- Content in various formulas, 231-232
- CSF values, 242
- Recommended dietary allowances, 230
- Serum normal values, 239
- Serum vs total serum solids, 246

Psychological testing, 88-92

- Denver developmental screening test, 91-92
- Goodenough-Harris draw-a-person test, 88-90

Pyelogram, 94

Quechenstedt test, 30

Rabies, immunization, 195

Red blood cell count, 11

Reducing substances in urine, 20, 22

Rees-Echer solution, 12

Regitine test, 82

Renal function, 25-29

- Acidification test, 28
- Creatinine clearance, 25
- Dilution and concentration, 26
- Three glass test, 27

Renal solute load, 231-232

Respiratory Care, 183

Reticulocyte count, 13

Rheumatic fever, synovial fluid, 34

Rheumatoid arthritis, synovial fluid, 34

Right to left shunt, estimation, 187

Rocky mountain spotted fever, immunization, 196

Roundworm ova, 37, 38

Rubella,

- Immunization, active, 196
- Immunization, passive, 198
- Incubation period, 200

Rule of nines, for burns, 181

Rumple-Leede test, 15

Salt-, Deprivation test, 80

Salicylate poisoning, 176-178

Diagnosis, 177

Therapy, 177

Sarcoid skin test (Kveim), 98

Schick test, 98

Schlesinger's test, 24

Sedimentation rate, 15

Serology, normal values, 241

Serum solids vs serum proteins, 246

Shunt, estimation of pulmonary, 187

Sickle preparation, 16

Skin tests, 97-99

- Cat scratch disease, 97
- Chancroid, 97
- Coccidioiden, 97
- Diphtheria toxoid, 98
- Echinococcus, 97
- Histoplasmin, 97
- Lymphogranuloma venereum (Frei), 97

- Skin tests (cont.)
 - Mumps, 98
 - Sarcoid, 98
 - Schick, 98
 - Toxoplasmosis, 98
 - Trichinella, 99
 - Tuberculin, 99
- Smallpox,
 - Immunization, 194
 - Incubation, 201
- Solution Composition,
 - Oral, 173
 - Parenteral, 174
- Spinal fluid, 30-32
- Starch, stool, test for, 40
- Steroid tests, 75-80
- Stool examinations, 37-41
 - Apt test, 39
 - Fecal fat, 40
 - Gelatinase activity, 39
 - Occult blood, 37
 - Parasitology preparation, 37, 38
 - Pinworm, 37
 - Starch, 40
 - Sugar, 40
 - TCA test, 39
 - Trypsin, 39
 - Urobilin, 41
- SU-4885, 78
- Sulkowitch test - urine calcium, 46
- Suprapubic, aspiration of urine, 5
- Surface area nomogram, 223
- Sweat test, 100
- TCA test, 39
- Teeth, eruption of,
 - Primary, 226
 - Secondary, 227
- Temperature, conversion formula, 250
- Tetanus,
 - Immunization, active, 192, 193
 - Immunization, passive, 198
- Three glass test, 27
- Thoracentesis, 7
- Thyroid tests, 70-71
 - Free ty, 70
 - PBI, 70
 - RAI (I^{131} Uptake), 70
 - T₃ Suppression, 70
 - Ty by column, 70
 - T.B.G. (Thyroxin binding globulin), 70
 - Thyroid antibodies, 71
 - TSH - immunoassay, 71
- Thypoid - immunization, 197
- Tidal Volume, 189
- Tolbutamide tolerance test, 44
- Tolerance tests, 42-45
 - Arginine, 74

Tolerance tests (cont.)

- Creatine, 45
- Epinephrine, 42
- Fructose, 43
- Galactose, 43
- Glucagon, 43
- Glucose, 42
- Insulin, 74
- Leucine, 44
- Phenylalanine, 45
- Tobutamide, 44
- Tryptophan load, 44

Tourniquet test (Rumpel-Leed), 15

Toxoplasmosis skin test, 98

Trichinella skin test, 99

Trypsin activity, duodenal secretions, 51

Tryptophan load test, 44

Tuberculosis,

- Immunization, 196

- Skin test, 99

T-waves, 64

Tympanoparacentesis, 6

Uremia, antibiotic doses in, 162-163

Urinalysis, routine, 18-21

Urine,

- Acidification test, 28

- Addis count, 27

- Bilirubin, 23

- Calcium, 46

- Catechol amines, 83

- Concentration test, 26

- Culture techniques, 35

- Cytomegatic inclusion disease, 22

- Dilution test, 26

- Exogenous pigments, 18, 19

- Ferric chloride test, 46

- Gonadotropins, 72

- Gram stain, 35

- Hemoglobin, 23

- Hemosiderin, 25

- HVA, 83

- Myoglobin, 23

- Mucopolysaccharide spot test, 48

- Pigments, exogenous, 18, 19

- pH, 28

- Porphyrinuria, 49

- Reducing substances, 22

- Steroids, 75, 76

- Suprapubic aspiration, 5

- Three glass test, 27

- Urobilin, 24

- Uroporphyrin, 49

- VMA, 83

Upper GI series, 93

Urobilin, 24

Uroporphyrin, 49

- Vaccines, 192-197
 - DPT, 192
 - Influenza, 195
 - Measles, 193
 - Mumps, 195
 - Polio, 193
 - Rabies, 195
 - Rocky Mountain spotted fever, 196
 - Rubella, 196
 - Smallpox, 194
 - Typhoid, 197
 - Tuberculosis, 196
- Vaccinia,
 - Immunization, 194, 198
 - Incubation periods, 201
- Vaginal smears, 72
- Vanillyl mandelic acid, 83
- Venapuncture, 3, 4
- Venous cutdown, 8
- Venous pressure, 9
- Vitamins, daily allowances, 230
- Water load test, 80
- Weight,
 - Conversion formula, 251
 - Normal values, 209-215
- White blood cell count, 11
- Whooping cough,
 - Immunization, 191, 192
 - Incubation, 201
- Wright's staining technique, 13
- X-ray examination, 93-95
 - Barium enema, 94
 - Cholecystogram, 95
 - Cystourethrogram, 95
 - Excretory urogram, 94
 - Herniogram, 95
 - Pelvic pneumography, 95
 - Psychological preparation, 93
 - Upper GI series, 93
- Xylose absorption, 53

0-8151-x